AIR ENGINEERING

FEBRUARY, 1961

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE, AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES

- *Will Air Conditioning Pay Off In Your Plant? How To Tell*
- *Ventilating An Automated Factory . . . Ford Transmission*
- *What You Should Know About Electrostatic Precipitator Sizing*
- *New Ideas In Industrial Ventilation*

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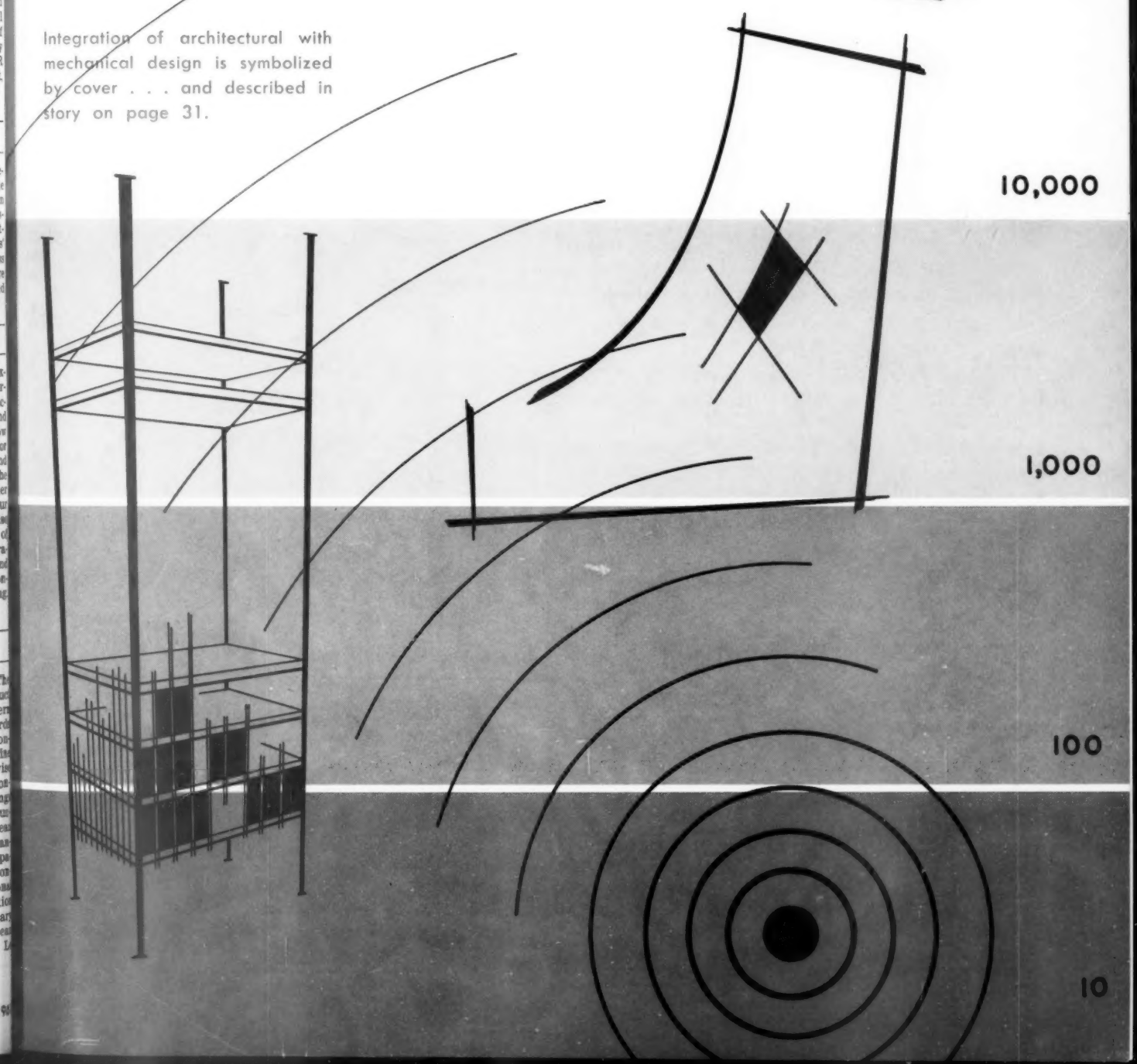
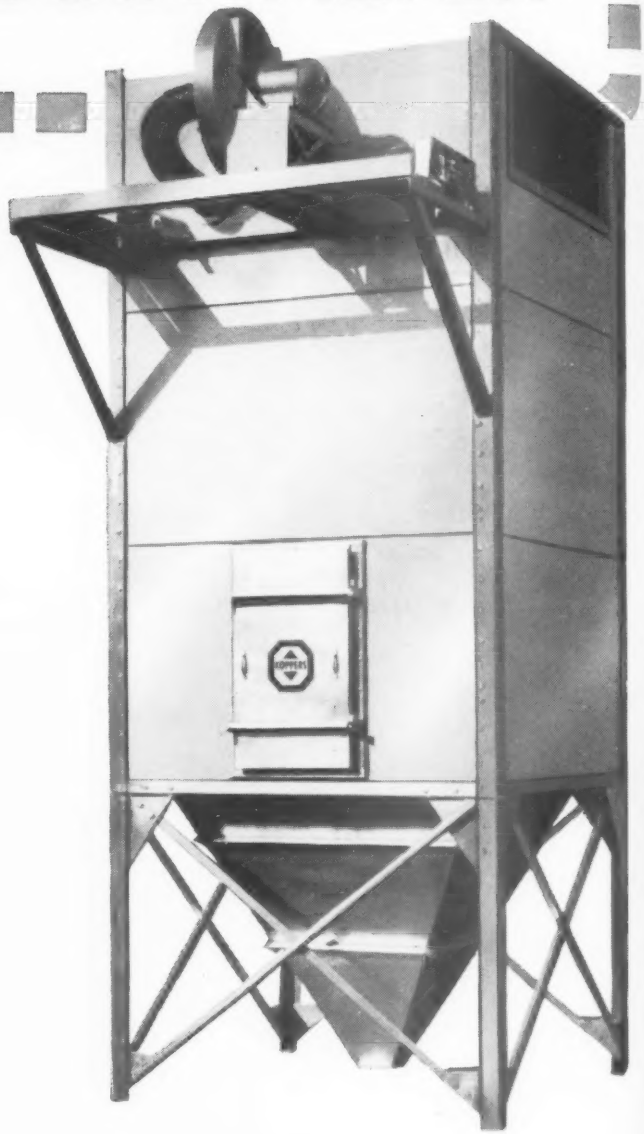
Integration of architectural with mechanical design is symbolized by cover . . . and described in story on page 31.



Reverse-air jet filtering comes of age with the

NEW KOPPERS MODEL K AEROTURN® DUST FILTER



NEW PERFORMANCE

Highest filtering efficiency and increased capacity are benefits you get in the all-new Model K Aeroturn. Fifteen years of diversified application experience have combined to produce a dust filter offering the utmost in performance and reliability.

NEW ECONOMY

Revolutionary new self-adjusting blow rings and proven pressure controlled filter cleaning reduce wear — increase filter tube life — cut operating expense. Rugged, simplified construction virtually eliminates maintenance costs and downtime.

NEW FEATURES

Koppers Model K Aeroturn has been completely redesigned for demanding industrial service—the only new reverse-air jet filter on the market. Such features as new blow rings, new carriage drive system and simplified, standardized design help you recover more product, cost less to operate and serve you more dependably.

NOW, MAIL THIS COUPON for complete information!

KOPPERS

AEROTURN® DUST FILTERS

Engineered Products Sold with Service

KOPPERS COMPANY, INC., Dust Filter Dept.,
4102 Scott Street, Baltimore 3, Md.

Gentlemen: Please send me a free copy of your new Aeroturn brochure complete with descriptions, drawings and photographs.

Name..... Title.....

Company.....

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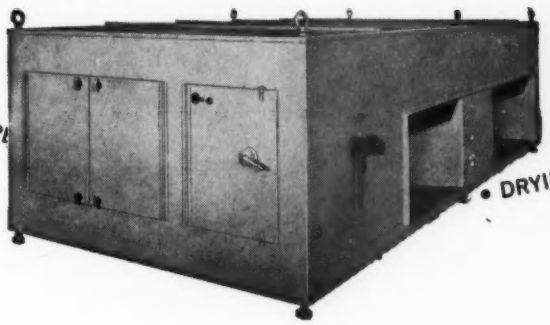
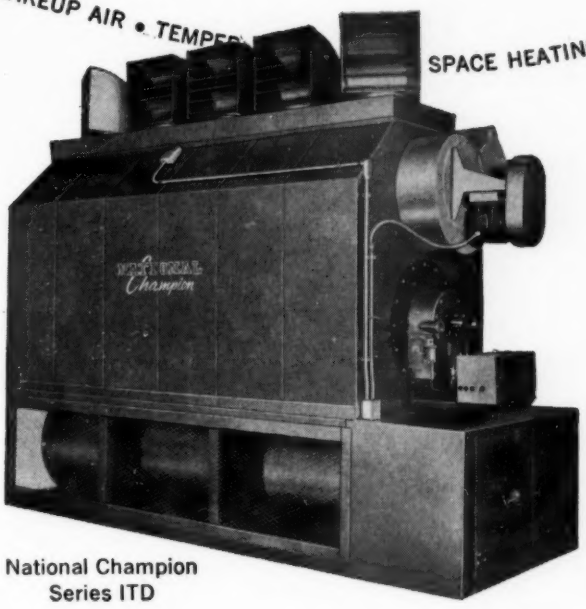
City..... Zone..... State.....

National Champion MA (makeup air)





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Series ITD

whatever your heating requirements

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From space heating to makeup air, National Leads the Industry!

National Champion space heaters offer the largest selection of styles and sizes to meet *every* heating requirement. *Only* National gives you a choice between custom-designed burners and heaters with conventional packaged burners.

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National Champion, Series ITD. 6 styles, 96 sizes —capacities 400,000 to 4,000,000 BTU's with gas, oil or combination fuel. UL & AGA approved.

National Champion MA (Direct-fired makeup air). Complete range of sizes from 8,000 to 150,000 CFM, full modulating 25 to 1 turn-down ratio.

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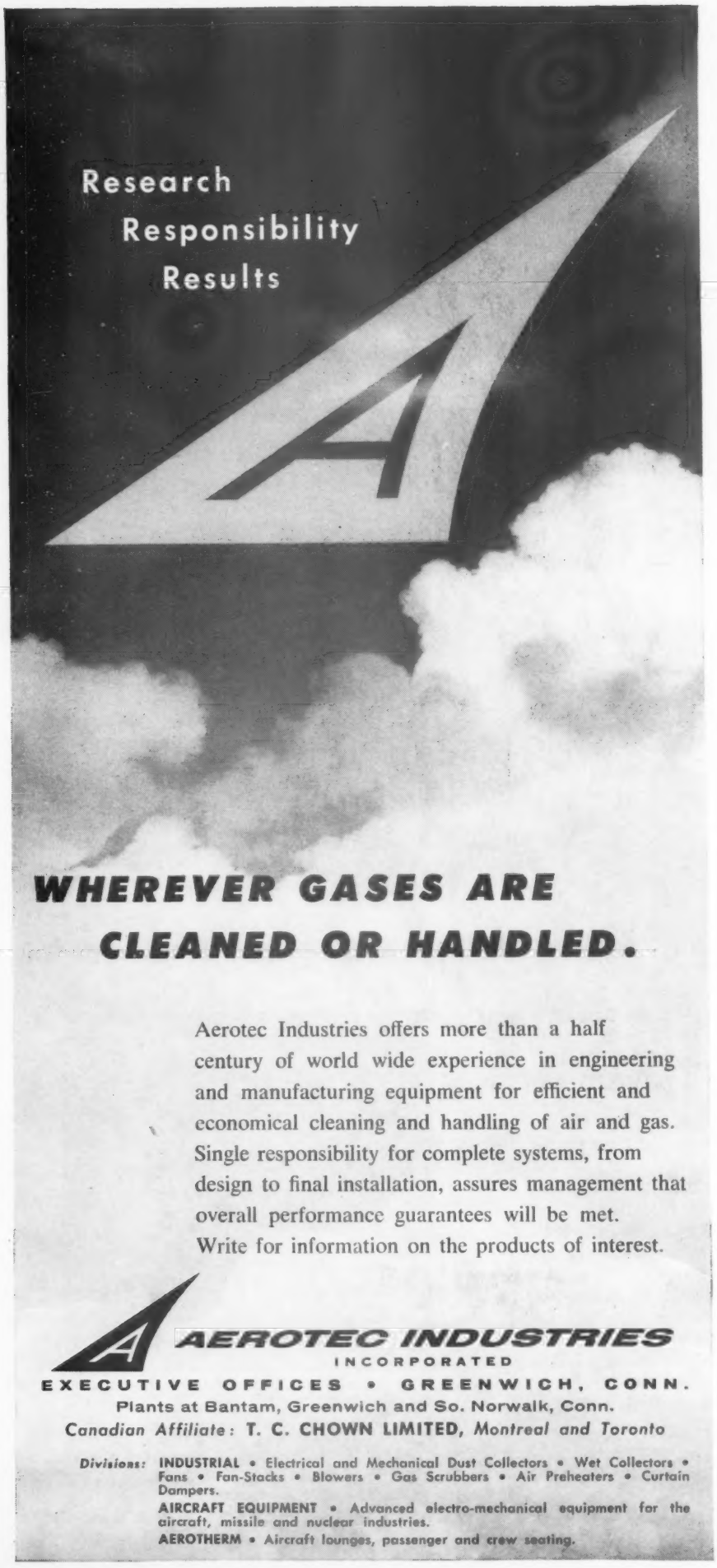
UNITS ON DISPLAY AT THE INTERNATIONAL HEATING AND AIR CONDITIONING EXPOSITION • FEBRUARY 13-16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Letters

Fan Speed As A Measurement For Air Delivery

Editor:

Mr. R. H. Seibert of the Marlo Coil Co. has suggested that I have not given enough consideration on fan speed as a measurement for air delivery in my AIR ENGINEERING series beginning April, 1960. I touched lightly on a number of subjects such as fan speed, any one of which might have been expanded to greater length.

The use of fan speed and static pressure would provide a far more accurate means of entering the multi-rating tables to find cfm than would motor horsepower and fan speed, for backwardly inclined blade fans, or for radial or forward curved blade fans under good design conditions. Where the static pressure at operating conditions is above the low point of the dip in the characteristic curve for the two latter designs, several different air flows are possible with the same speed and horsepower. For such installations, the primary means for determining delivery should be the direct measurement of air flow.

Fan Speed A Variable

Essentially, although I did not stress this point in my article, the fan speed is used as the final balancing variable in order to obtain the designed (or required) total fan delivery. It should be noted that, for a given system of ductwork, a speed increase of 10 percent will increase the air flow by 10 percent but that this will be accompanied by a 33 percent increase in brake horsepower. It was for this reason that, in Part 3 of the article (June, 1960) the 115 percent load continuous operation of integral horsepower open motors has been mentioned. It would have perhaps been wise to elaborate somewhat on the necessity to avoid overloading the fan motor when speeding up the fan, but it was assumed that the readers of AIR ENGINEERING would check the motor input with a clamp-on ammeter as a precaution.

S. A. Littmann
Chief Mechanical Engineer
Giffels and Rossetti, Inc.
Detroit, Michigan

AIR ENGINEERING

VOL. 3, NO. 2

FEBRUARY, 1961

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE,
AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES

FEATURES

The Economics Of Industrial Air Conditioning 20

If your production goes down when the temperature goes up, you should check into these accounting methods for predetermining profit in cooling.

Ventilating An Automated Factory 26

by Eugene A. Carsey, assistant chief engineer, Kirk & Blum and Lowell Shimp, construction project engineer, Ford Motor Co. Describes many ventilation problems and their solution in Ford's automatic transmission plant.

Integrating Architectural With Mechanical Design Cuts Costs Of Both 31

by Gershon Meckler, owner, Meckler Engineers, consulting engineers. Author gives details on three buildings to prove that integration of building design with the mechanical system design cuts overall costs.

Space And Size Requirements For Electrostatic Precipitators 34

by E. P. Stastny, chief project engineer, Industrial Gas Cleaning Dep't., Koppers Co. Factors influencing size of precipitators are detailed.

What's New In Industrial Ventilation 39

by James C. Barrett, Ventilation Consultant, Div. Occupational Health, Michigan Dep't. of Health. New and better ways of controlling dust and fumes from processes in construction and manufacturing.

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COVER

Cover drawing by Meckler Engineering of Toledo, Ohio shows this consulting engineering firm's philosophy on integrating architectural with mechanical system design. See p. 31.

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Air Pollution In Reverse?

Dr. S. F. Singer, University of Maryland, has a theory that there may be a ring of dust particles 600 to 1,000 mi. above the earth's surface that periodically rids the Van Allen radiation belts of much of their deadly concentration of protons and electrons.

If it is proved, astronautic scientists would have the first manmade method of insuring radiation-free flights for men into and out of the earth's atmosphere. They could use dust as a shield for manned space vehicles at these stages of such flights.

Air Pollution Out-Foxes The Hounds

Foxhounds in Britain are losing the scents of foxes because auto fumes and agricultural chemical fumes are throwing the dogs off the trail.

Hunt masters are trying to breed dogs more suited to the new conditions, but it is difficult because the artificial smells get stronger every year.

Needed . . . Anti-Air Pollution Vaccine?

According to R. Lewis, Ph. D., Tulane University, and A. Roberts, M. D., Chief of Clinical Investigations Unit, U. S. Public Health Service, there is reason to believe that undramatic, day to day air pollution affects the productivity of the people exposed and operates as an underlying agent for many disease conditions.

New White Room Association

Final preparations are being completed for *"The American Association For Control Of Super-Clean Areas"* for engineers who design, operate, and maintain white rooms or application engineers of manufacturers who furnish white room components and supplies.

For more information see the News of the Industry section, this issue.

$1 Million To Be Spent On Air Pollution

Over the next two years Owens-Corning Fiberglas Corp. plans to spend over $1 million on air pollution control equipment for its Santa Clara plant. All equipment will be designed to meet the requirements of the Bay Area Air Pollution Control District.

During 1959 and 1960 the company spent $110,000 for air pollution control engineering and equipment.

High Rate Of Lung Cancer Among Uranium Miners

A long term study of uranium workers by the U. S. Public Health Service showed: Death rate from lung cancer among uranium miners is five times as great as that of U. S. men in general.

The cause seemed clear: radon, a dense gas that emanates from uranium, is highly radioactive and breaks down into products that are radioactive too. Investigators found air in 50 percent of the mines in Colorado and Arizona four or five times above the safe level of radiation.

Colorado's Governor McNichols charged that the Atomic Energy Commission has forced the price of uranium so low that small mine operators cannot afford proper safeguards and ventilation for their miners.

. . . in Chicago's new Exposition Center

Impressive main entrance to Chicago's Exposition Center, magnificent new mecca for exhibitors and conventioneers. Inset, right, shows one arrangement of the many Dorex filters.

996 DOREX AIR RECOVERY FILTERS SAVE 800 TONS OF AIR CONDITIONING CAPACITY

. . . and provide relief from the irritant-heavy atmosphere of shows, conventions, exhibits

In the new 34 million dollar Exposition Center at McCormick Place, 996 high efficiency Dorex activated carbon filters—the largest installation of its kind in the world—purge recirculated air of irritants and purify it for sanitary re-use in the Center's vast air conditioning system.

But from the Center's profitable-operation point of view, Dorex air recovery is even more important. Serving 350,000 square feet of exhibition space, the filter system will have almost one million cfm recirculated through it . . . representing a saving of 800 tons of air conditioning capacity at an installed cost of approximately $360 per ton, for a total saving of over $300,000! And further tremendous savings in operating costs will be realized!

Thirty years of research, development, and application, plus a systematic replacement service that ensures the continuous effective operation of every installation, make Dorex the best method of AIR RECOVERY and ODOR CONTROL.

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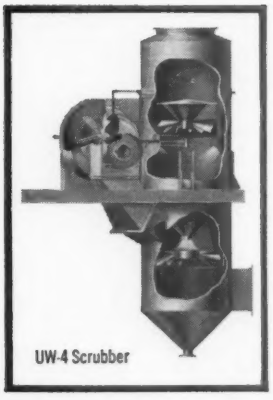
THE SWIRL, SWAT AND SCRUB METHOD OF CONTROLLING DUST



UW-4 Scrubber

There's an old song that goes something like this: "It Ain't What You Do; It's The Way That You Do It." This holds true for wet dust collection and one of the most effective ways of **doing** it is dynamically with a Ducon UW-4 Scrubber.

The centrifugal forces and water action inside this scrubber, combining with the unique and effective dynamic action of the high velocity fan in the second stage of operation, literally swirl, swat and scrub all the dust particles from the gas stream.

The UW-4 Scrubber is a most effective unit for separation of extremely fine dusts and abrasive materials and is ideally suited for heavy dust loads and high temperature applications.

Send for Bulletin 7460.

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Canadian Branch:

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EDITORIAL:

The Case For Factory Air Conditioning . . .

IT'S TIME TO PROGRESS beyond the outmoded concept that the only reason to air condition all or part of a factory is to cool the products or the machines that make them.

Fact is, we have looked too long at factory air conditioning purely as process air conditioning . . . which explains why only some two percent of the factories in this country are cooled throughout.

It's at least as important, and probably more so, to conceive of air conditioning as a people-cooler, as well as a machine or product cooler.

The reason why you should adopt this total concept of factory air conditioning, which includes people, is *not* only because people produce so much more when it's cool than when it's hot. The relationship between man's thermal environment and his work productivity has been established beyond all doubt.

What *hasn't* been established, up to now, has been proof positive, *before* buying and installing air conditioning machinery, that the investment will pay off as well or better than any other piece of capital equipment.

Now, as told in an article on the economics of industrial air conditioning, (page 20, this issue of AIR ENGINEERING) the techniques of factory cost analysis and accounting have been applied to plant air conditioning.

With these new accounting methods, it is now relatively easy to prove to the hardest-headed plant manager or board of directors, that air conditioning will pay for itself.

We predict that the application of sound accounting analysis to industrial air conditioning will open the door to a vastly increased market for cooling equipment.

After all, the sale of costly production tools and machinery, has always had to be made on the basis of an acceptable return on the investment. Up to now, about the only air conditioning sold on this basis has been for production processes, such as textile manufacture, that could scarcely get along without it.

Now, by combining the knowledge we already have of the effect of a proper thermal environment on man's productive ability and his work efficiency,

(Please turn to following page)

Editorial *(Cont.)*

(Continued from preceding page)

and the tremendous cost of training new employees to replace those who leave to work in air conditioned plants . . . with the principles of modern cost accounting . . . we can come up with facts and figures to prove the case for cooling beyond all doubt.

Several manufacturers of air conditioning equipment have spent considerable time and money cobbling together workable accounting analysis of factory cooling costs. Intimate and detailed before-and-after studies have been made in hundreds of factories to obtain raw data for these procedures.

Minneapolis-Honeywell Regulator Co.; Perfection Div. of Hupp Corp., and Carrier Corp., are among the firms that have done much to broaden factory air conditioning application by means of modern accounting methods.

Kudos belong in particular to Carrier for their fine, detailed cost analysis forms. We have a copy on our desk, and in it there's an accounting made of every factor in the plant that bears on air conditioning, except the night watchman's false teeth. Only thing left out is how to figure cooling costs . . . and that's been worked out to a gnat's eyebrow long ago, as any air conditioning textbook will reveal.

Now you have a do-it-yourself air conditioning analysis kit that you can use to sell management on cooling the plant.

Take another look at your plant . . . chances are good you can use this kit to sell your management air conditioning *before* next summer's first heat wave raises hob with production. ▲▲

Eugene A. Sloane

Editor

Meetings, Courses, Expositions

American Society of Heating, Refrigerating, and Air-Conditioning Engineers semi-annual meeting and exposition, *International Amphitheatre, Chicago, Feb. 13-16, 1961.*

10th Annual Industrial Ventilation Conference, *Kellogg Center, Michigan State U., East Lansing, Michigan, Feb. 20-23, 1961.*

11th Annual ISA Conference on Instrumentation for the Iron & Steel Industry, *Roosevelt Hotel, Pittsburgh, March 8-10, 1961.*

National Assn. of Corrosion Engineers (annual conference and Corrosion Show), *Statler hotel, Buffalo, N. Y., March 13-17, 1961.*

139th Annual American Chemical Society, *St. Louis, Missouri, March 21-30, 1961.*

National Assn. of Refrigerated Warehouses, Inc. and The Refrigeration Research Foundation, *Mark Hopkins Hotel, San Francisco, Calif., March 27-30, 1961.*

3rd Symposium on Temperature—Its Measurement and Control in Science and Industry, *Veteran's Memorial Hall, Columbus, Ohio, March 27-31, 1961.*

Gas Appliance Manufacturers Assn., *Boca Raton Hotel, Boca Raton, Florida, April 5-7, 1961.*

American Industrial Hygiene Conference, *Sheraton-Cadillac Hotel, Detroit, April 10-13, 1961.*

7th National ISA Symposium on Instrumental Methods of Analysis, *Shamrock-Hilton Hotel, Houston, Texas, April 17-19, 1961.*

39th Annual Convention of the Oil Heat Institute of America, *Statler-Hilton, Washington, D. C., April 23-27, 1961.*

National Assn. of Electrical Distributors (annual convention), *Detroit, April 29-May 3, 1961.*

Consulting Engineers Council, *Chicago, Illinois, May 4-6, 1961.*

4th National ISA Power Instrumentation Symposium, *LaSalle Hotel, Chicago, May 8-10, 1961.*

12th Annual National Conference of the American Institute of Industrial Engineers, *Sheraton Cadillac, Detroit, May 11-13, 1961.*

Industrial Heating Equipment Association, Inc., *The Homestead, Hot Springs, Virginia, May 21-24, 1961.*

Air Pollution Instrumentation Symposium, *Hotel Commodore, New York, June 12, 1961.*

Electrical Precipitation Seminar, *The Pennsylvania State University, University Park, Pennsylvania, June 12-17, 1961.*

3rd Biennial International Gas Chromatography Symposium, *Kellogg Center, Michigan State U., East Lansing, Mich., June 13-16, 1961.*

4th International Conference on Bio-Medical Electronics; 14th Conference on Electronic Techniques in Medicine & Biology, *Waldorf-Astoria Hotel, New York, July 9-14, 1961.*

Atomic Shelter Seminar, *The Pennsylvania State University, University Park, Pennsylvania, July 10-22, 1961.*

Joint Nuclear Instrumentation Symposium, *North Carolina State College, Raleigh, N. C., Sept. 6-8, 1961.*

Production Engineering Show, *Navy Pier, Chicago, Illinois, September 6-16, 1961.*

ISA Fall Instrument-Automation Conference & Exhibit, *Memorial Sports Arena, Los Angeles, Calif., Sept. 11-15, 1961.*

National Metal Exposition, *Detroit, October 23-27, 1961.*

First International Convention on Ionization of Air, Technical, Physical and Physiological Aspects, *Ben Franklin Institute, Philadelphia, Pennsylvania, October 16-17, 1961.*

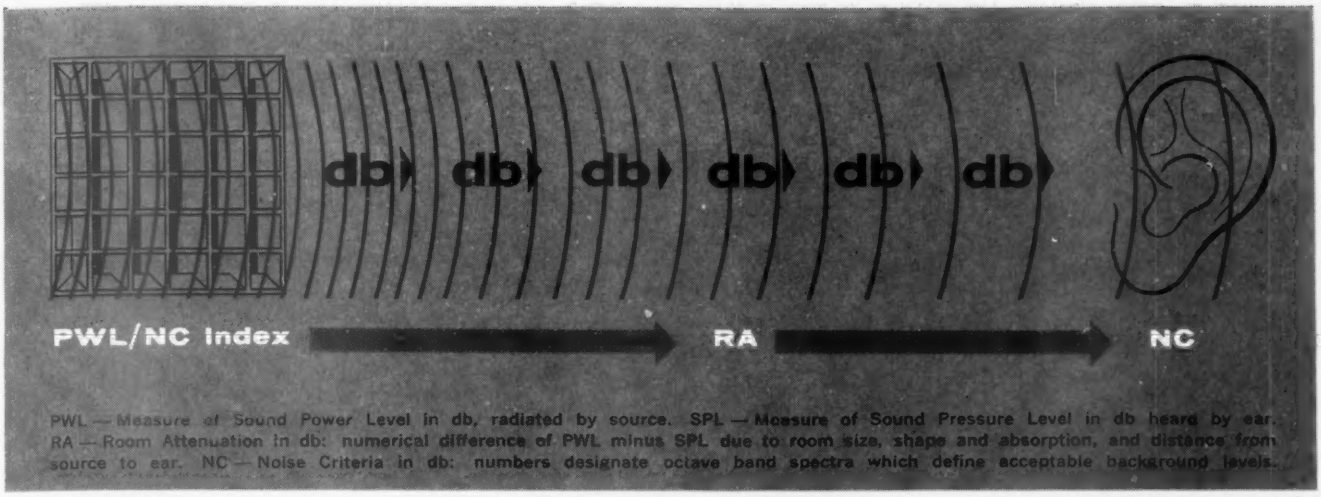
National Frozen Food Distributors Assn., *Chicago, Nov. 6-10, 1961.*

Air-Conditioning and Refrigeration Institute (annual meeting), *The Homestead, Hot Springs, Virginia, Nov. 12-15, 1961.*

National Warm Air Heating and Air Conditioning Assn. (annual convention), *La Salle Hotel, Chicago, Nov. 13-16, 1961.*

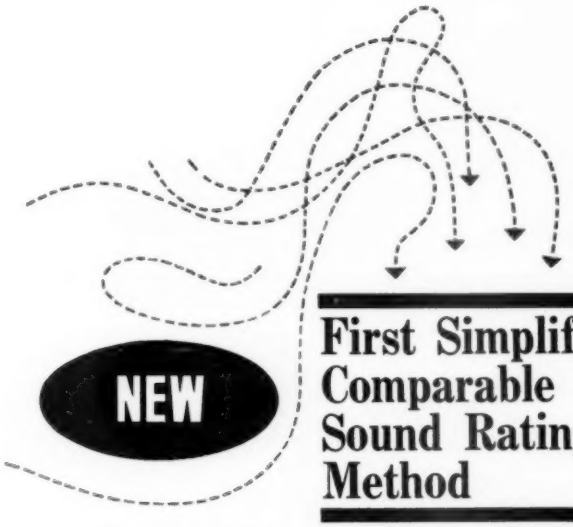
National Electrical Manufacturers Assn. (annual meeting), *Traymore Hotel, Atlantic City, New Jersey, Nov. 13-17, 1961.*

National Assn. of Home Builders, *Exposition Center, Chicago, Dec. 3-7, 1961.*



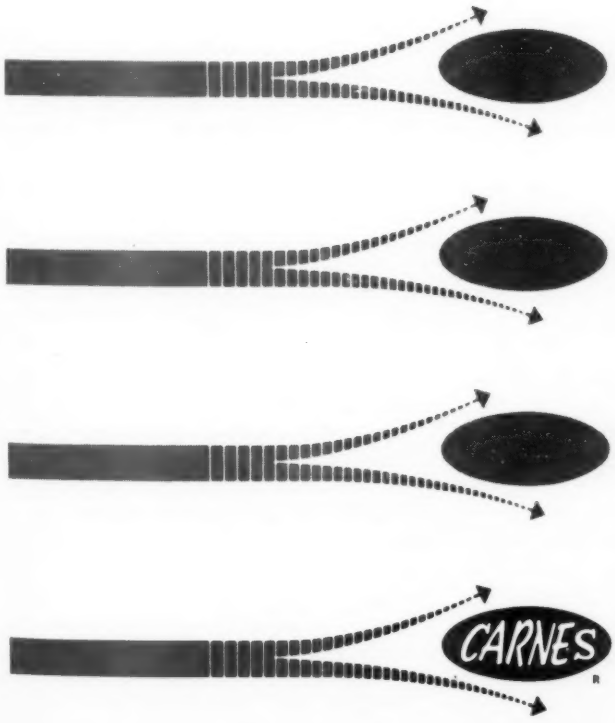
PWL — Measure of Sound Power Level in db, radiated by source. SPL — Measure of Sound Pressure Level in db heard by ear. RA — Room Attenuation in db: numerical difference of PWL minus SPL due to room size, shape and absorption, and distance from source to ear. NC — Noise Criteria in db: numbers designate octave band spectra which define acceptable background levels.

LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION



NEW

First Simplified Comparable Sound Rating Method



NEW NEW NEW NEW

PWL/NC INDEX

CARNES PUBLISHED ITS NEW CONCEPT IN 1959.

The old rating method of judging units — based on the "A" Scale or Sound Pressure Level (SPL) as heard by the ear from a non-standard distance in a non-standard room . . . yielded non-comparable values, and for comparable rating of manufacturers' units is all but useless.

Carnes' method eliminates those variables and rates the Sound Power Level (PWL) radiated by the source at the source. This workable, simple, easy to use method permits establishing a single number for rating performance, yet covers the pertinent information which makes the octave band analysis desirable. PWL/NC Index is a number assigned to the PWL spectrum of a unit (when discharging a specified CFM) which indicates the minimum NC(PWL) curve that will not be exceeded in any band. The NC(SPL) curve which will not be exceeded in any band will be the PWL/NC Index minus Room Attenuation. Carnes' facilities and techniques are in accord with the standards which have been proposed by the ASA and ASHRAE. Write for complete details on Carnes published Sound Rating Method.

Carnes manufactures High and Low-Velocity ATC Units • Modular, Round, Rectangular, Square, Convertible and Baseboard Diffusers • Registers • Grilles • Roof and Wall Ventilators.

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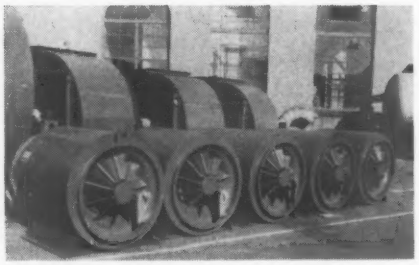
NEWS of the Industry

New Centrifugal Fan Design Saves Floor Space

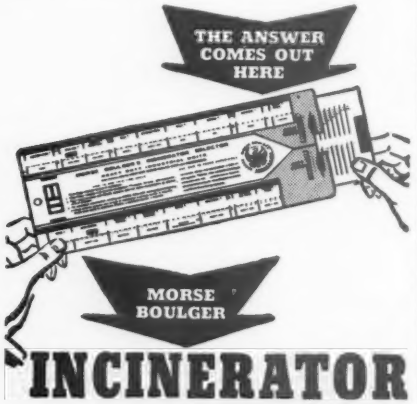
By using 49 in-line Airfoil centrifugal fans, approximately 1,000,000 sq. ft. of the Travelers Insurance Company Building in Hartford, Connecticut, can be air conditioned without losing valuable floor space.

Because of the versatility of the Centriline® fans, Jansen and Rogen Consulting Engineers, have been able to position some of the 49 fans one above the other. The stable pressure characteristic also makes it possible to install the fans in parallel, such as is the case in The Travelers high pressure dual-duct system where separate "hot deck" and "cold deck" fans draw air from heating and cooling coils and discharge into separate distribution ducts.

Other cost saving factors: simpler installations due to inlet and outlet dimensions requiring one size of duct without transformations; and fewer elbows and duct turns, cutting down sheetmetal work and increasing efficiency of the system. Fans by Sturtevant Div., Westinghouse Electric Corp.



In the foreground, part of the 49 Centriline fans in The Travelers new air conditioning system are ready to be installed.



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One of these tremendous time-savers will be sent free when requested on your professional or business stationery.

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Today's engineering plus more than 70 years experience building incinerators of all types and sizes.

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Member: Incinerator Institute of America
Air Pollution Control Association

Hospitals Aided By UV Protection

A system of direct ultraviolet radiation that is said to drastically reduce post-operative infection is being offered to hospitals by Westinghouse Electric Corp., George B. Saviers, manager of the special products group of the company's lamp division, announced that professional services will be offered to hospitals interested in installing ultraviolet protection in their operating rooms.

An ultraviolet engineering staff is to furnish hospitals with information and technical assistance so that each ultraviolet installation is tailored to the needs of individual operating rooms.

Included on the staff is Dr. Rudolph Nagy, who is in charge of ultraviolet and biochemical research for Westinghouse and a prominent authority in the ultraviolet field. Dr. Nagy recently jointly-contributed a three-part series on air sanitation with ultraviolet light for AIR ENGINEERING (Oct.-Dec., 1960).

British Manufacture Lint-Free Gauze

The Samuel Courtauld Co., a British enterprise, has come up with a lint-free gauze for use in areas where the exclusion of dust particles is important. It is reported that the product, made from Taslan viscose rayon yarn, has found wide acceptance among scientific and optical equipment manufacturers.

The gauze is claimed to be capable of absorbing liquid up to 7½ times its own weight and has chemical properties which make it suitable for a variety of cleaning purposes. It is unaffected by most organic solvents, mineral acids and common alkalis in dilute solutions, can withstand temperatures of up to 150°C for short periods.

Women, Lipstick and White Rooms

Unlike polar bears in a snowstorm, you can distinguish women workers from the sea of white caps and smocks in the "White Room" of Leach Corporation, Los Angeles electronic firm. Red lips, courtesy of management, does it. The company, rather than buck a minor female revolt against a lipstick taboo, supplies free "no-flake, no-smear" red paint.

Why the compromise? The room where delicate electronic parts are assembled must be virtually 100 percent free of contaminants—no dust, hair, face powder or lipstick flakes. Women are willing to sacrifice most symbols of their femininity to work in this antiseptic atmosphere. Surrender they did face powder, long nails, pretty hair, stylish dresses. But not the lipstick. The company okayed wearing the indelible kind. How to make sure that only this type was used? Free lipsticks—the only way to establish quality control (without blushes).

Why is it, no matter how important the job, a woman must look her very best, or her work is second best?

Find Way To Scrub CO_2 Out Of Air

During the December meeting of the New York Academy of Sciences, a method of protecting men against carbon-dioxide poisoning, in submarines, space craft or other confined quarters was described.

The submarine medical specialist is Dr. K. E. Schaefer, former German naval doctor and Heidelberg professor, now head of the physiology branch of the U. S. Naval Medical Research Laboratory, New London, Conn.

Carbon dioxide under normal conditions makes up three-hundredths of one per cent (0.03 per cent) of the atmosphere; in a nuclear-powered submarine it may rise, safely to one and a half per cent (1.5 per cent)—fifty times the normal concentration.

In nuclear-powered submarines carbon-dioxide may rise beyond the safe level, and this makes necessary development of techniques to "scrub" it from the atmosphere. Dr. Schaefer described the use of amines—chemicals resembling the ammonium molecule—to achieve this end.

One of them, monoethanol amine, he described as a self-regenerating carbon-dioxide scrubbing agent. That is, it absorbs carbon dioxide when cooled and releases it when heated under pressure. The gas thus removed from the submarine atmosphere can be released overboard into the water.

U.S.A.F. Awards $380,000 Contract

Flexible Tubing Corporation of Guilford has announced receipt of U. S. Air Force contracts totaling over $380,000 during October for the manufacture of 12,000 duct assemblies for use on Air Force portable heaters and air conditioners.

According to Frederick K. Daggett, president, the duct assemblies will be used by the Air Force in both jet and conventional aircraft as well as in the missile program.

"The ducts," he said, "are of prime importance in helping to control temperature requirements under extreme cold weather conditions as well as high temperature conditions encountered in tropic and desert environments."

(Please turn to following page)

Performing a TOP JOB...
The MIKRO-PULSAIRE
DUST COLLECTOR

Installed at the Hawaiian Cement Company's new plant at Barber's Point, Oahu, you'll find a total of nineteen MIKRO-PULSAIRE Dust Collectors, four of which are pictured above.

Because it has no moving parts . . . internally or in the gas stream . . . the MIKRO-PULSAIRE has proved ideally suited to handling highly abrasive materials such as cement. Other features to be considered are its record of 99.9% *plus* recovery, and high air-to-cloth filter ratio. Our Hawaiian installation provides a total filtering capacity of 329,928 cfm. Whatever your requirements, the MIKRO-PULSAIRE can deliver a top job for you, economically and with maximum dependability.

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NEWS of the Industry . . .

(Continued from preceding page)

New Association Underway, Issues White Room Papers

A complete set of reprints of the papers given at the Nov. 1, 1960, Symposium on Dust Control and White Rooms, Tempe, Arizona, is available at $5.00 per set. Send your order to Editor, AIR ENGINEERING.

The set includes: *Dust Monitoring In The Super-Clean Room By The Dry Slide Settling Technique* by R. C. Marsh, Physicist, W. J. Whitfield, Physicist, and I. M. Kodel, Engineer, Sandia Corp., Albuquerque, New Mexico; *White Room — Ultra Precision Instruments* by J. R. Mildon, Plant Engineer, Lear, Inc., Grand Rapids, Michigan; *Determination and Detection of Air Contaminants* by A. Lieberman, Research Chemical Engineer, Armour Research Foundation of Illinois Institute of Technology, Chicago; *The Philosophy of Dust Control at Autonetics* by W. R. Jerome, Manufacturing Engineer, North American Aviation, Inc., Downey, Calif.; *Dust Control and White Rooms* by E. F. Casey, Plant Engineer, North American Aviation, Canoga Park, Calif.

A by-product of the symposium was the formation of a professional association specifically concerned with the design, operation and maintenance of white rooms, super-clean rooms, contamination control and allied problems.

The new association will be known as American Association for Control of Super Clean Areas. It is planned to include as members, engineers who design super-clean areas, engineers who operate and maintain them, and application engineers of manufacturers who furnish white room components and supplies.

For further information about membership contact Editor, AIR ENGINEERING.

Registration Law Declared Illegal

Federal Judge R. M. Freeman recently ruled that Michigan's law requiring registration of architects and engineers is unconstitutional.

He held that the 25-year-old statute violates the Fourteenth Amendment of the U. S. Constitution because "it is too vague."

The judge also ruled that Ohio's statute—almost identical to Michigan's when applied to registration of architects and engineers who come up through the ranks (unregistered) or those who are college trained (registered) — is equally unconstitutional.

Judge Freeman refused to dismiss a suit involving Modern En-

(Please turn to page 14)

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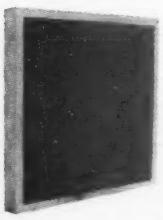

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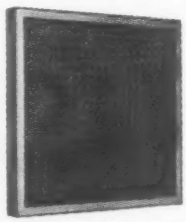

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Chemico P-A Venturi Gas Washer Chosen By Kaiser For No. 1 Blast Furnace

The venturi washer at the Kaiser plant is just one of fifty CHEMICO venturi washers specified and installed by major steel producers for cleaning blast furnace gas. Performance figures and maintenance records of blast furnaces using CHEMICO venturi washers indicate the following:

1 The CHEMICO venturi washer is the most efficient wet washer in operation anywhere. Where higher top pressures are available, for example, gas can be cleaned to less than 0.003 Gr/Scf, eliminating the need for secondary precipitators.

2 CHEMICO venturi washers require virtually no maintenance for an entire furnace campaign.

3 Capital and installation costs are less than other primary or secondary gas cleaners.

4 Minimum space is required. Generally, the CHEMICO venturi washer is set into space formerly occupied by gas mains.

5 Water requirements are about a third of other wet washers.

6 Latest designs incorporate adiustable controls which enable maximum gas cleaning efficiency to be maintained regardless of wind rate.

If you are considering the installation of gas cleaning equipment on a blast furnace, a CHEMICO representative would be pleased to show you the kind of top-performance job you can expect from a Venturi washer. CHEMICO handles the complete job, **Planning, Design, Engineering, Erection and Start-up.**

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NEWS of the Industry . . .

(Continued from page 12)

gineering Services Co. and General Electric Co. The ruling followed efforts by G-E to have a five-year-old suit dismissed because the Berkley firm's engineers were not registered in Michigan and Ohio.

According to Rex Eames, attorney for Modern Engineering, the decision clears the way for the original suit and sets a precedent.

"The state has never before forced an issue on whether an engineer was registered or unregister," Eames stated.

The suit was filed as the result of a dispute in which Modern Enengineering Services billed G-E $150,000 for automating its Cincinnati plant. G-E believed the bill was excessive and refused to pay on the grounds that the firm's engineers were not registered, "contrary to state law."

Automatic Supply Of Make-Up Air

At the Graniteville Co., Graniteville, S. C., 1,000,000 cfm of plant air is exhausted by dry cans, mercerizing ranges, wash ranges, resin curing ranges, and other bleachery equipment. Thirty-five to 40 exhaust hoods continually discharge this processed air, but only 60 percent of this air is replaced by the heating and ventilating systems, and the circulation system designed to prevent condensation on the ceiling. Without an additional air supply, this loss of air would produce a negative pressure and cause drafts at doorways and windows, as air tried to replace that which was exhausted.

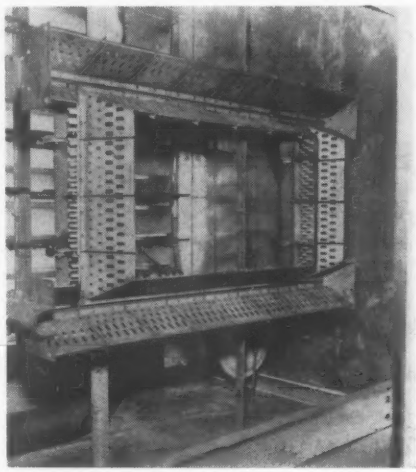

Fig. 2: *Close-up of gas burner to heat air in the winter. Louvers and shut-down dampers are shown behind burner.* →

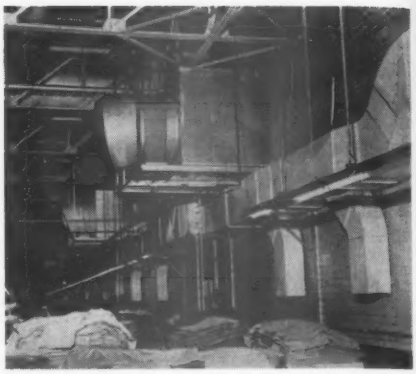

Fig. 1: *Three of the four 60,000 cfm air make-up units.*

Four Units Installed

Four newly designed "packaged" make-up air units were installed, which supply 60,000 cfm each and bring the total replacement of air up to 80 percent of that exhausted. The replacement air can be brought in as high as 80°F by automatic controls on the back of the units.

The four "packaged" make-up air units were supplied by the J. O. Ross Engineering Division of the Midland-Ross Corp., New York.

Conference On Air Ions

An International Conference On Ionization Of The Air will be held October 16-17 at Ben Franklin Institute in Philadelphia.

Plans for the meeting are under way at this time. Scientists from Russia have been invited, though no confirmation as to their arrival or topic of paper has been received.

Those interested in attending may obtain further information from Igho C. Kornblueh, M.D., secretary of the American Institute of Medical Climatology, 1618 Allengrove Street, Philadelphia 24, or Clarence W. Hansell, Ph.D., R.C.A. Laboratories, Princeton, N. J.

The meeting is sponsored by the American Institute Of Medical Climatology, an association formed in 1958 to promote "the sciences

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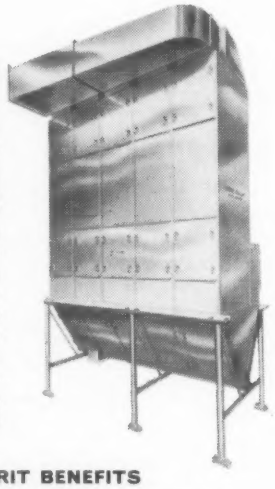

Save real dollars with the benefits from this automatic dust collector. No more interruptions on production lines! Maintenance problems are practically eliminated. This all new continuously cycling TORIT dust collector automatically cleans your air and automatically shakes its own filters and blows them clean with reverse air flow. Collected material is emptied automatically.

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of bioclimatology and biometeorology. Among others, the association has sections on meteorology, air pollution, climatology, atmospheric electricity and public health.

Memberships are open to qualified persons at $5.00 per year, with sustaining memberships at $100 per year for corporations. More information on memberships can be obtained from Dr. Kornblueh.

The Phila. Study

Three major projects are to be conducted in Philadelphia relating to studies on the relationship between air pollution and health.

The first of these studies is concerned with atmospheric lead in the city of Philadelphia. The U. S. Public Health Service has set up a study to determine the variation of lead in the atmosphere from combustion of gasoline, industrial, and commercial activities. The plans for this project are nearing completion.

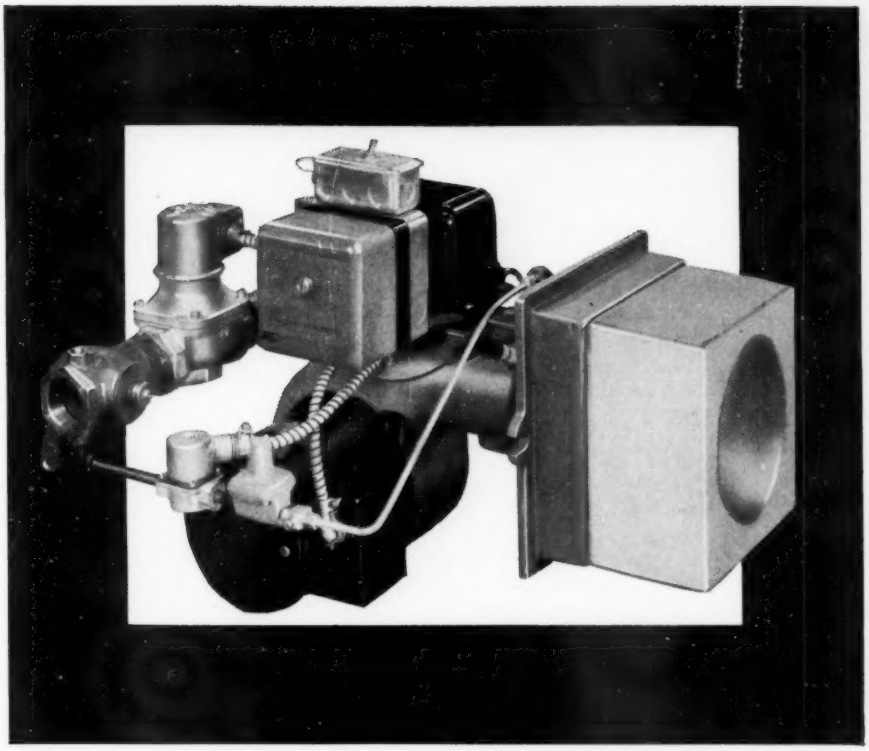
Part Of National Network

The Public Health Service has also announced that this city is one of six American cities that has been selected for expanding its network of sampling for gaseous contaminants. The first station will be set up downtown to sample for sulfur dioxide, nitrogen oxide, nitrogen dioxide, carbon monoxide, hydrocarbons and oxidants. The automatic sampling instruments, costing between 2500 and 4000 dollars each, are set up for minute to minute recording to obtain extensive information on the diurnal and daily variation on these gases of significance to air pollution.

The department is extending cooperation to a group of industrial physicians on studies of sulfur dioxide in the atmosphere as related to industrial absenteeism by making air sampling data available to this group for study.

"Rare" Pollutions

Baltimore has had several rare experiences in the field of air pollution. In one instance ladies' nylon stockings that disintegrated in the downtown area received considerable interest and news coverage. Investigation showed the condition resulted from the emission of oil soot from the boiler of a hotel in the area.



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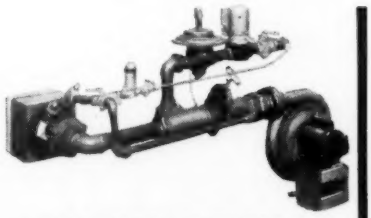
All models are factory-assembled, tested, and shipped complete, including combustion block, ready for installation.

Model 800 SIB, shown above, has a capacity range from 100,000 - 900,000 Btu/hr. Package includes pilotstat or electronic flame safety protection, spark ignition, and blower for combustion air. Available in five different assemblies for a variety of needs.

Bulletin H-51-C describes this burner assembly in detail. Write for your copy today.



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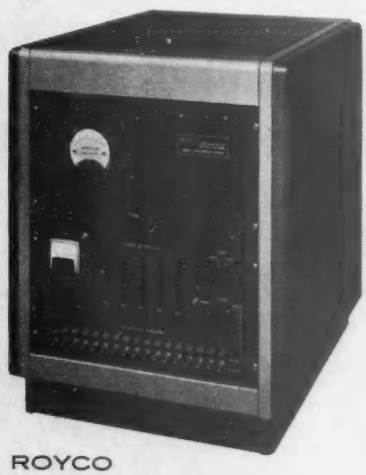

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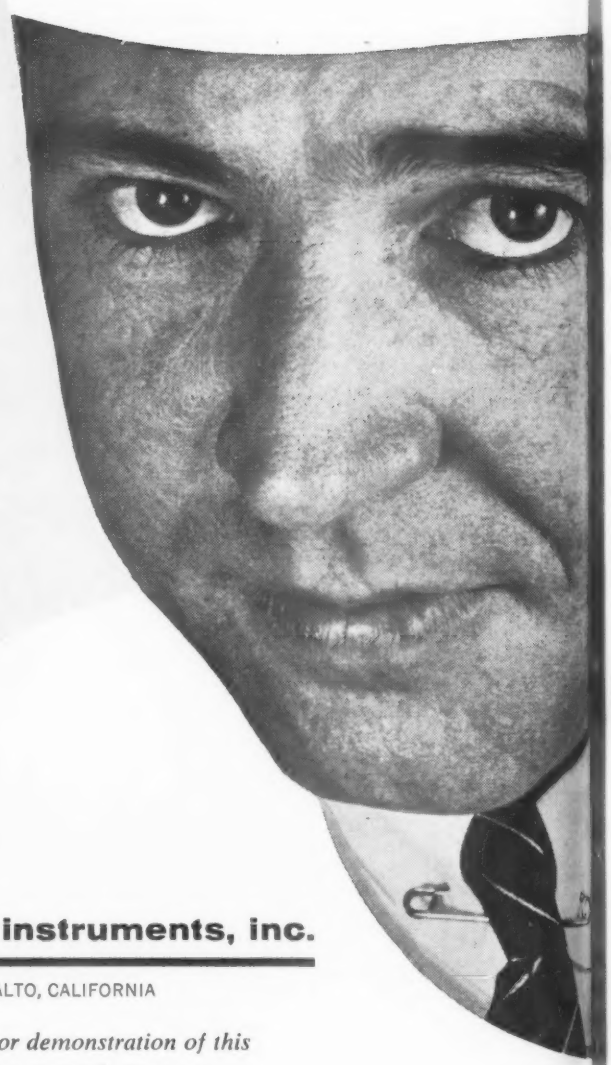

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15th International **ASHRAE** *Show Chicago, February 13-16, 1961*

AIR ENGINEERING extends a cordial invitation to stop by booth #342 at the 15th International Heating & Air Conditioning Exposition, sponsored by the American Society of Heating, Refrigerating and Air Conditioning Engineers. The Exposition will be held February 13-16 at the International Amphitheatre, Chicago, Monday through Thursday, 12 noon to 10 P. M. daily. Special bus service will run from all the major hotels to the Amphitheatre.

More than 500 displays of equipment for commercial, institutional, industrial and domestic application will be shown. Covering every phase of heating, cooling, refrigeration, ventilation, air purification and moisture control, including materials, parts, supplies and tools used throughout the industry.

During the same period, the American Society of Heating, Refrigerating and Air Conditioning Engineers will hold their semi-annual meeting at the Conrad Hilton Hotel. On the agenda will be the installation of new officers, during the Tuesday evening Banquet, February 14 at 7:30 P. M.

A series of four technical sessions, six symposiums, conferences, forums, and committee meetings, to be held at the Conrad Hilton, are also planned. A few of the papers that should be of interest to our readers: Monday, February 13th, 9:30 A. M., Williford Room, **Corrosion Inhibition in Steel Tubes in Low Pressure Steam Boilers** by W. A. Keilbaugh, Head, and F. J. Pocock, Senior Chemist, Chemical Section, Research Center, Babcock & Wilcox Co.; 10:10 A. M., **Evaluation of Wet Cell Air Humidifiers** by Dr. M. W. First, Consulting Engineer.

Tuesday, February 14th, 9:30 A. M., Waldorf Room; **Medium Temperature Water Heating Symposium,** to include, **Pipe and Pump Size Reduction with MTW Systems, Heat Transfer—Effect of Increased Temperature Drop on Valve Control, Effect of System Temperature on Pump Curve and Pressure-Drop Curve,** and **Pressurization of MTW Systems.** Also Tuesday at 9:30 A. M. in the Upper Tower Room: **Air Movement, Humidity, and Humidity Control,** to include, **Comfort and Physiological Adjustment of People to Environment, Air Motion and Movement.**

Two forums will be held Tuesday at 2:00 P. M. in the Williford Room: in parlor A, **Better Environments for Learning** and in parlor C, **Corrosion of Air Conditioner Components.**

Wednesday, February 15th, at 9:30 A. M., in the Waldorf Room there will be a **Symposium on Environment, Odors, Sound, and Solar Radiation on Fenestration.** Another forum at 2:00 P. M. in the Williford Room, parlor C on **Status of Thermoelectric Refrigeration.**

Thursday, February 16th, at 9:30 A. M. in the Waldorf Room: **Ventilation Symposium,** to include, **Field Check of Ventilation and Air Conditioning Systems, Industrial Ventilation Systems,** and **Ventilation Systems with Special Requirements.**

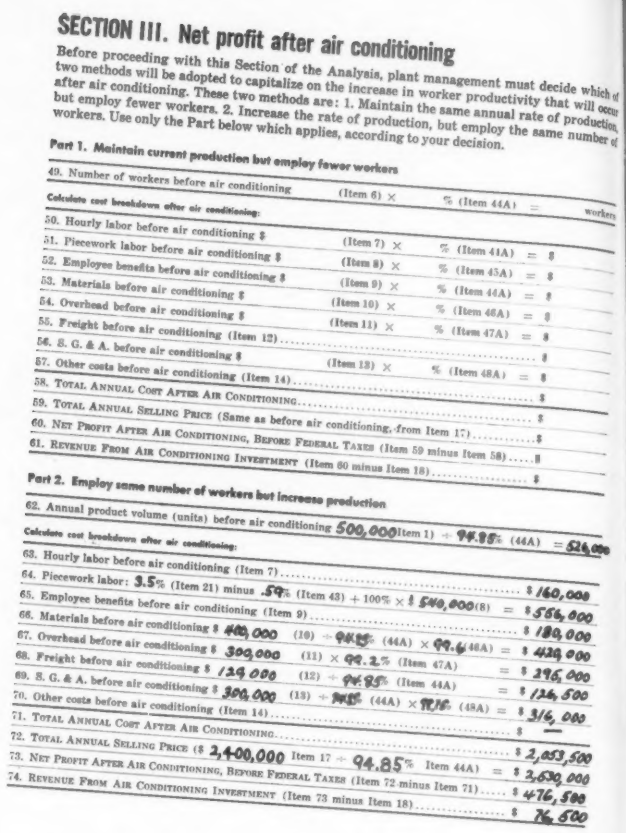
A social calendar for you and your wife has been planned. For further information contact the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 234 Fifth Ave., New York City.

Be sure to stop by booth #342 and say "hello."

The Economic$ Of Factory Air Conditioning

by Eugene A. Sloane

If you're located in a hot summer climate, if your production takes a tailspin in hot weather, if quality goes down and absenteeism goes up with the thermometer, you owe it to yourself to investigate whether or not air conditioning in your plant will pay dividends. Check these ideas.



SECTION III. Net profit after air conditioning

Before proceeding with this Section of the Analysis, plant management must decide which of two methods will be adopted to capitalize on the increase in worker productivity that will occur after air conditioning. These two methods are: 1. Maintain the same annual rate of production, but employ fewer workers. 2. Increase the rate of production, but employ the same number of workers. Use only the Part below which applies, according to your decision.

Part 1. Maintain current production but employ fewer workers

49. Number of workers before air conditioning	(Item 6) ×	% (Item 44A) =	workers
Calculate cost breakdown after air conditioning:			
50. Hourly labor before air conditioning $	(Item 7) ×	% (Item 41A) =	$
51. Piecework labor before air conditioning $	(Item 8) ×	% (Item 45A) =	$
52. Employee benefits before air conditioning $	(Item 9) ×	% (Item 44A) =	$
53. Materials before air conditioning $	(Item 10) ×	% (Item 46A) =	$
54. Overhead before air conditioning $	(Item 11) ×	% (Item 47A) =	$
55. Freight before air conditioning (Item 12)			$
56. S. G. & A. before air conditioning $	(Item 13) ×	% (Item 48A) =	$
57. Other costs before air conditioning (Item 14)			$
58. TOTAL ANNUAL COST AFTER AIR CONDITIONING			$
59. TOTAL ANNUAL SELLING PRICE (Same as before air conditioning, from Item 17)			$
60. NET PROFIT AFTER AIR CONDITIONING, BEFORE FEDERAL TAXES (Item 59 minus Item 58)			$
61. REVENUE FROM AIR CONDITIONING INVESTMENT (Item 60 minus Item 18)			$

Part 2. Employ same number of workers but increase production

62. Annual product volume (units) before air conditioning 500,000 (Item 1) ÷ 94.85% (44A)			= 526,000
Calculate cost breakdown after air conditioning:			
63. Hourly labor before air conditioning (Item 7)			$ 160,000
64. Piecework labor: 3.5% (Item 21) minus .5% (Item 43) + 100% × $ 540,000 (8)			= $ 564,000
65. Employee benefits before air conditioning (Item 9)			$ 180,000
66. Materials before air conditioning $ 400,000 (10) ÷ 94.85% (44A) × 99.6% (46A)			= $ 420,000
67. Overhead before air conditioning $ 300,000 (11) × 99.2% (Item 47A)			= $ 296,000
68. Freight before air conditioning $ 129,000 (12) ÷ 94.85% (Item 44A)			= $ 124,500
69. S. G. & A. before air conditioning $ 300,000 (13) ÷ 94.85% (44A) × 98.1% (48A)			= $ 314,000
70. Other costs before air conditioning (Item 14)			$
71. TOTAL ANNUAL COST AFTER AIR CONDITIONING			$
72. TOTAL ANNUAL SELLING PRICE ($ 2,400,000 Item 17 ÷ 94.85% Item 44A)			= $ 2,053,500
73. NET PROFIT AFTER AIR CONDITIONING, BEFORE FEDERAL TAXES (Item 72 minus Item 71)			= $ 2,530,000
74. REVENUE FROM AIR CONDITIONING INVESTMENT (Item 73 minus Item 18)			$ 476,500
			$ 76,500

Above: *Part of a comprehensive Industrial Air Conditioning Analysis Form prepared by Carrier Corp., for evaluating economic return from factory air conditioning. The 8-pages of this form cover all cost factors involved.*

THE CASE FOR INDUSTRIAL comfort air conditioning has been proved over and over again in hundreds of factories making everything from socks to satellites.

Let's face it . . . if your plant is located where summers are hot and sticky, production is going to suffer during summer, no matter how you slice profit and loss statements. In production areas where there's a high internal heat *gain* from machinery . . . in the drafting room . . . in engineering, planning and research, there's bound to be a summer slump, a slow-down.

You've probably been putting up with summer slump for years, wondering whether air conditioning would pay off.

We're happy to report you can stop wondering . . . and start figuring, because there's a way to pretty accurately predict how air conditioning, just like any other capital investment, will give you more than a net return on your money. You can actually make money on air conditioning equipment . . . and this article aims to show you how.

Before going into facts and figures of industrial cooling costs, let's examine the experience of other firms. Table 1 lists 14 well known firms who have found air conditioning to pay for itself in terms of increased production, reduced rejects, and absenteeism, savings in personnel training, improved product quality, savings on maintenance and housekeeping.

Ten of these plants made from 26% to 122% return on their investment in factory air conditioning.

Table II lists 14 yardsticks which can help you survey your own plant to determine if air conditioning will pay off on a dollar and cents basis.

The Case For Industrial Air Conditioning

There are sound, scientific, medically proved facts you can use to support your case for air conditioning all or part of the plant, . . . facts which can help forecast the amount of increased production, decreased reject rate, quality improvement, etc., to be expected when body heat stresses are removed by air conditioning.

For example, research has shown that when heat and humidity soar above optimum (let's say when it's 90° @ 65% rh), accident frequency will increase 35 percent or more. You can be sure that a rash of small accidents on an assembly line, where close cooperation between workers is required, will raise hob with production output.

In long periods of wireless code reception, errors increased from an average of 12 per hour to more than 90 per hour as effective temperature was increased from 70° to 97°.

(Please turn to page 22)

RETURN ON INVESTMENT

TABLE I

TABLE I

RETURN ON INVESTMENT
TYPICAL FACTORY COMFORT AIR CONDITIONING

PLANT NAME AND LOCATION	PRODUCTS MANUFACTURED	THE PROBLEMS	% RETURN ON INVESTMENT *	PER CENT SAVED DURING SUMMER ONLY				
				IMPROVED WORKER EFFICIENCY	REDUCED REJECTS	REDUCED CLEANING	REDUCED TRAINING	REDUCED PERSONNEL EXPENSE	REDUCED ABSENTEEISM
Acme Visible Records Crozet, Va. (1)	Visible Records Systems	Low work capacity per worker, humidity curling edges of paper stock, corrosion and rust of unfinished metal sheets, bonded wood-and-paper products can be produced only in the winter.	35%	8 Min/Hr		(All of these benefits are in addition to 35% return)			
Simson Electric Co. Chicago, Ill. (1)	Electronic Test Equipment	High reject rate, quality control problems, low summer output per worker, plant maintenance too high.	80%	3½%	68%	50%	6%	33%	
Densal Mfg. Co. W. Springfield, Mass. (1)	Metal-Etched and Lithographed Instrument Dials and Nameplates	Early factory shutdowns during hot weather, low profits during summer months, worker capacity low.	122%	(Production up 70%, payroll up 25%, net profit up 83% for July, Aug. & Sept., 1959 versus same period 1958)					
Buxton, Inc. Springfield, Mass. (1)	Billfold, Key Cases, and Other Leather Products	High absenteeism, labor turnover, reject rate, spoilage, low morale and loss of working hours during the summer.	37%	5%		(All of these benefits are in addition to 37% return)			
Elgin Watch Co. Elgin, Ill. (1)	Watch Manufacturer	Low worker efficiency, low productivity on precision work, reject rate high.	75%	6 Min/Hr	20%	10%	Large Reduction		
Sylvania Electric Prod. Altoona, Pa. (1)	Electronic Equipment	Low summer production, high rate or absenteeism, high reject rate.	30%	5%	80%		22.6%		20%
Rockwell Mfg. Co. Topulo, Miss., Etc. (1)	Meters, Valves, and Power Tools	Low work output in summer months, low morale, high reject rate, high rate of absenteeism and worker turnover.	26%	4.5% Annually		(All of these benefits are in addition to 26% return)			
Ship 'N Shore, Inc. Upland, Pa. (1)	Girls' and Women's Blouses	Largest market during the summer months when employees work output was the lowest, high reject rate, high rate in employee turnover, high rate of absenteeism and low morale.	33%	10% Annually		($15,000 annual training program eliminated)			
Star Machine & Tool Co. Cleveland, Ohio (1)	Precision Tools	Low rate of accuracy, high reject rate, during summer months a high rate of absenteeism and labor turnover.	31%	5.1% Annually			30%		14%
Daystrom Transicoil Worcester, Pa. (1)	Servo-Mechanisms	Low summer production, high rate of absenteeism, high reject rate, high labor turnover.	41%	2.7%	5%		25%		Virtually Eliminated
Kleer-Vu Brownsville, Tenn. (1)	Acetate Billfold Accessories, Job Ticket Envelopes, Transparent Sheet Protectors	Low summer output, high rate of absenteeism, high labor turnover, softening of acetate in summer, frequent machine adjusting.	32%	6.5%					17%
Detroit Edison Co. Detroit, Mich. (2)	Electrical	Production decreased in draft room during summer.		51%					
C. F. Braun & Co. Alhambra, Calif. (2)	Chemical Mfg.	Reduced efficiency output during hot weather.		35%					
John Hardy & Son Pulaski, Tenn. (2)	Nylon Hosiery	Low production rate, high cost of maintenance.		29%		80%			

KEY * *Equal to net return, after taxes, on air conditioning investment.* (1) *Information obtained from Carrier Air Conditioning Co., Syracuse, New York.*
(2) *Information obtained from Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

Economic$ Of Factory Air Conditioning

(Continued from page 20)

When indoor temperature and humidity reach the "emotional boiling point" industrial unrest increases sharply, union grievances multiply.

It's a well known fact that crimes of passion, assault and battery and crime rates in general, climb during periods of summer heat stress.

Personnel who must work together on an assembly line soon establish a working rhythm which is thrown out of kilter when hot, muggy, indoor climate imposes demands on the human body that interferes with ability to concentrate, reduces manual dexterity, lowers the emotional boiling point.

The problem is aggravated by the fact that closely knit groups of workers tend to establish that pace which will see them through 12-months of the year, and if heat stress cuts this pace during the summer, this reduced pace will likely be the one maintained during the winter, so air conditioning can pay off in increased productivity the entire year.

Let's examine the physiological basis of heat stress. When the body is subject to high temperatures and humidities, skin blood vessels swell with blood moving so rapidly that about half the blood pumped by the heart goes directly to the skin and back to the heart . . . *short-circuiting the brain, muscles and other vital organs.* Thus our brain is less efficient, mental alertness is reduced, muscular coordination impaired . . . which explains why slips on the production line can occur which cause accidents, lose time, and increase the reject rate.

By the time sweat appears on a man's face, his bodily cooling mechanism has already diverted enough blood from brain and muscles to cause coordination and alertness trouble. If sweat appears and humidity is so high skin evaporation effect is impaired, worker production is going to slow up, and the worker may be subject to heat prostration.

First experience in this country with large-scale factory air conditioning was in newly built war plants, many of them more or less windowless. A good example is the Convair plant in Dallas, in which production records were established as compared with

Yardsticks To Determine If Air Conditioning Will Pay In Your Plant

1. Is the plant located in an area of high summer heat and humidity?
2. Do production and quality go down during hot weather?
3. Is worker cooperation and teamwork important to you? Does hot weather affect smooth running production lines?
4. Is absenteeism a problem during summer months? Does 15 percent or more of your job force turnover yearly? Is turnover high during summer?
5. Does assembly of your product require a high order of manual dexterity, muscular coordination?
6. Are your products susceptible to damage from rust, dirt, mildew?
7. Are there many sources of high internal heat gain, as from electric motors, ovens, heat treating furnaces, lights, solar gain, etc.?
8. Do you have a high "Population Density" of worker per sq. ft. (One or more persons for each 300 sq. ft. of floor space)?
9. Check departments listed below. If increased worker efficiency meets data given, you can most likely pay for air conditioning out of savings alone:
   Punch Press 2% • Machine Shop 1.6% • Metal Finishing 1.8% • Bellows 2% • Tool Room 1% • Die Repair .6% • All Dep'ts. 1.5%
10. Are people involved in exacting labor, repetitive work, jobs where heat and fumes cause physical and emotional fatigue?
11. Does labor account for more than 25 percent of the manufacturing cost of your product?
12. Check each department to be air conditioned, ask department head how much he feels air conditioning will save per hour per worker. Figure factors such as stopping to wipe off sweat, extra trips to water cooler, extra rest periods, improved worker efficiency when heat stress is removed. Average answer received by Carrier engineers, for example, is five minutes/hour/man. Convert savings into percent annual savings in labor cost.
13. If you can figure a 1½ percent increase in production due to the air conditioning investment, and total costs for air conditioning during the amortization period are less than 25 percent of the total *gross* wages of personnel in air conditioned area, you have a sound economic basis on which to justify air conditioning.
14. Checking chart, figure length of your cooling season, payroll costs per sq. ft. and increased efficiency (more production) needed to pay for air conditioning. (The curves consider first, operating and owning costs, interest, taxes, etc. Check also chart II, Equivalent Cost of Typical Factory Comfort Air Conditioning.

16 Reasons Why You Should Air Condition Your Factory

1. Increased employee efficiency, up to 10 percent annually.
2. Good return on investment in cooling system, up to 122 percent.
3. More production, up to 70 percent.
4. Better quality control fewer rejects—fewer errors, up to 80 percent.
5. Maintenance savings, less dust, etc.—up to 50 percent.
6. Humidity control for comfort and process.
7. Reduced absenteeism during hot weather — up to 20 percent.
8. Reduced training expense from labor turnover—up to 30 percent less.
9. Reduced labor turnover.
10. Fewer union grievances.
11. More good will, morale.
12. Better competitive position in labor market.
13. Reduced accident rate.
14. Longer life of plant facilities operating in clean, dry air at reduced operating temperatures.
15. Improved customer relations due to fewer field product failures.
16. Reduced hiring expense, personnel dep't. costs.

other similar but un-air conditioned plants.

A report on the Convair plant, 18 years after, will be made in an early issue of AIR ENGINEERING.)

Statistical research that proved the case for air conditioning, by the General Services Administration of the Federal Government, has been so widely publicized as to scarcely bear repeating. A few facts from this study are worth remembering however, and using in your efforts to sell management air conditioning. The GSA made a study of two identical areas, one air conditioned, the other not. It was found that air conditioning upped work production to 9½ percent, decreased absenteeism 2½ percent, reduced errors .9 percent. It was found that a production increase of 1½ percent would pay for air conditioning.

Factory Cooling Research

Further research by the GSA in factories turned up an 80 percent drop in maintenance costs in a nylon hosiery plant and an average 25 to 30 percent drop in absenteeism reported by 75 manufacturing plants.

Related Benefits: Reduced absenteeism and labor turnover saves the $1500 or more it costs to train each new worker; cuts personnel department overhead; increases life of capital cost machinery subject to harm by rust from "sweating" during periods of high humidity.

Thus, to your initial calculations on air conditioning as a paying investment in your plant, add a factor for reduced employee training, tied to a decrease in labor turnover.

For example, Ship 'N Shore, women's blouse manufacturer of Upland, Pa., saved $15,000 annually by dropping a training program for new employees, found unnecessary when old employees stuck to their job during hot summer months. In this plant over-all production rose 10 percent and return on investment in cooling equipment ran 33 percent, enough to pay for the system in three years. (There will be detailed case history studies on this plant, and on Schick, Inc., and Sylvania Electric Products, Inc. plants, to follow in subsequent issues of AIR ENGINEERING.)

Cost Data on Factory Air Conditioning

Three manufacturers have come up with cost studies intended to prove the case for industrial air conditioning. Since they differ somewhat, and since they approach the problem from different angles, each of the three methods are given here. You may wish to borrow from each of the three methods to put together your own cost figures.

Hupp Corporation

The Perfection Division of the Hupp Corporation has made studies on economics of industrial air conditioning based on using packaged units which may range up to 75 or more tons each.

(Please turn to following page)

Right: *Air conditioning in Ship'N Shore, Inc., plant at Upland, Pa., helps workers like the girl at pressing operation boost total production from plant by 10% annually, give management handsome 33% return on investment in cooling. Photo courtesy Carrier Air Conditioning Co.*

(Continued from preceding page)

Carl W. Millsom, vice president, suggests the following formula:

$$\frac{\text{Gross Annual Wage}}{4} = X$$

$$\frac{X}{\text{No. of workers in plant or area to be conditioned}} = \text{Costs of air conditioning per worker}$$

As a rule of thumb, not more than 25 percent of total *GROSS* wages of workers in plant areas to be air conditioned should be invested in cooling equipment. This rule will pay off if only 1½ percent increase in production is attained, though many plants report increases far in excess of 1½ percent.

One figure to use, according to Millsom, for estimating industrial cooling costs is $1.00 per sq. ft. This figure includes the complete job, installed, and is based on using packaged equipment and installation of water tower where required.

The $1.00/sq. ft. figure is based on cooling 400 sq. ft. with one ton of refrigeration . . . or cost of refrigeration, installed, at $400/ton and 1-ton/400 sq. ft. and very little cooling load other than people and lights. Cooling costs are directly related to internal heat gains, as from motors or other heat producing operations.

Cost/sq. ft. can be equated with payroll costs for length of average cooling season to calculate efficiency increase required to make the system pay for itself. Chart I relates length of heating season, payroll costs/sq. ft. and increased efficiency needed to pay for air conditioning.

Curves show, for example, that increased production needed during 15-week period to pay both owning and operating cost is only 3.1 percent. These costs include interest, taxes, depreciation, etc.

Carrier Corporation

A five part analysis of plant area(s) to be air conditioned is recommended by Carrier. This fairly detailed study will require close coordination between plant engineering, production and accounting department, will delve deeply into figures on costs and profits, can be put together in a few hours.

1. *Costs and Profits before Air Conditioning* – In this section dollar values are established for various items of (1) cost, (2) income and (3) profits for the most recent typical year. Here

14 Practical Ways To Reduce Cooling Costs

1. Use existing ductwork and air handling equipment, with minor modifications, to handle air conditioning.
2. Keep plant closed up and run cooling equipment at night to store cooling in walls, machinery, etc., and so reduce size of cooling equipment. Power rates are generally less at night.
3. For operations where air conditioning may not be practical, but heat is a problem as in steel mills, foundries, consider air conditioned "rest areas" where personnel can recuperate from heat exposure.
4. Check water consumption in your plant, volume may be enough to use in a water cooled condenser first before going to the plant for process use, thus eliminating cooling tower.
5. Remember, it isn't necessary to bring temperature and humidity down to levels found in offices . . . 80° at 40 percent rh is plenty good enough in the plant area when it's 95° in the shade outside and humidity is a crawling 65 percent or worse.
6. In general, it's as important to reduce the *humidity* as it is the temperature, although both should be done. Reduced humidity permits bodily heat removing functions to work at greater efficiency.
7. Install needed equipment in hottest, "problem" spots now, add more later when budget permits.
8. Consider lease arrangements for packaged air conditioning equipment.
9. Exhaust cooled, conditioned air out through hot spots, such as foundry, paint spray room, etc., where air conditioning may not be practical.
10. Consider pinpointing air conditioning at isolated hot spots instead of cooling whole plant to cool a few people. Package units ideal for this application.
11. Forget about 20 to 30 ft. ceilings . . . supply conditioned air at 8 to 10 ft., figure job as if ceiling were at 12 ft.
12. If you use packaged units, avoid long duct and pipe runs, try to deliver air direct from outlet grilles on unit. Air can be delivered further, with higher velocities, than in commercial job because noise isn't as much of a factor.
13. Ventilate or partition off areas of extreme heat from rest of shop. Contain heat producing areas so you are cooling only the personnel.
14. Check actual operating time and heat output of machinery. You may be able to save by figuring a 50 hp motor, if used for only 10 percent of the time, as a 15 hp motor, thus cutting cooling costs.

basic information, such as the number of pieces of product produced annually, over-all costs, number of workers and average cost per unit are recorded for later use. The dollar value for items like hourly labor, employee benefits, manufacturing overhead, materials, and sales, general and administrative, and their percent of total cost are also listed.

2. *Evaluation of Benefits provided by Air Conditioning* – The five major benefits usually provided by factory air conditioning are increased worker output, reduced worker training, fewer rejects, lower housekeeping costs and more economical personnel administration. In using the analysis form, each of these five benefit areas are evaluated by plant managers, who are guided by their previous production records and cost figures. Each item is expressed in terms of its percent of total cost.

   For example, plant superintendents are asked the approximate number of minutes they believe that could be saved per hour, per worker by maintaining a comfortable atmosphere during the hot summer months. One extra trip to the water cooler plus a little conversation could lose eight minutes per day, or one minute per hour per man. The average answer Carrier has received is five minutes per hour per man. Each estimate is then converted into a percent of annual saving in labor cost.

   Incentive pay for piecework, also considered, provides an economical interpretation of the beneficial effects to the worker and the company when air conditioning is permitted to reduce product labor cost.

3. *Net Profit after Air Conditioning* – Percentages previously computed are applied against the various categories of operating expense. The results are new values for expense and production volume and the net profit to be expected after air conditioning is in operation.

4. *Total Cost of Air Conditioning* – How much will it cost to reap the bigger return is detailed here. All major costs for a complete, ready-to-operate system, including any construction work or extra wiring, are itemized. Experience, plus a number of curves (like Fig. 1) based on recent factory air conditioning installations help Carrier engineers to accurately estimate job costs on the spot.

5. *Return on Air Conditioning Investment* – The number of years required to pay off the cost of the investment and the percent return on the investment result from the summary of potentials with air conditioning.

Carrier reports it is not unusual to find that the percent of return on investment is high. *The answer seems incredibly high because the estimated percentages of improvement are so small.* Occasionally, plant managers wish to reduce their original estimates. Even when new figures based on what plant representatives know are conservative are submitted, the final result is still high.

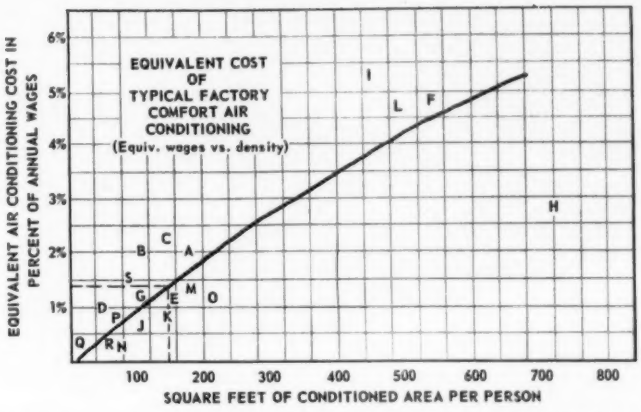


Chart I: *Chart shows equivalent cost of typical factory comfort air conditioning installation by wages, sq.ft. of floor space and related to plant population density. Chart courtesy Carrier Air Conditioning Co.*

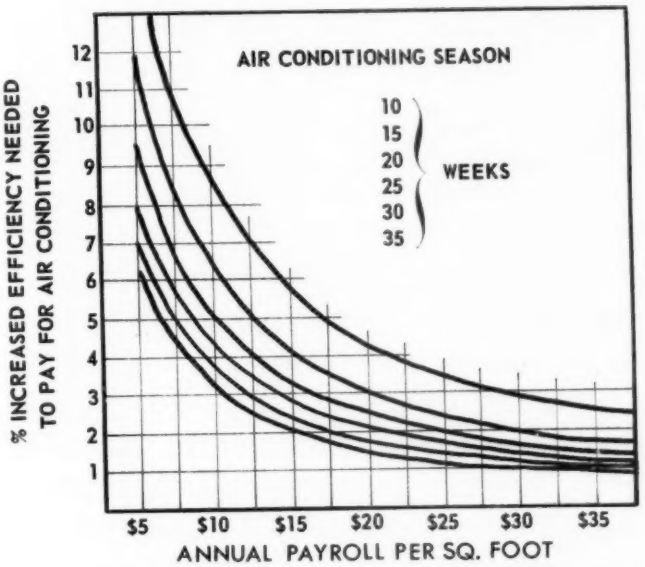


Chart II: *Curves show efficiency increase required to pay for air conditioning at various cost factors. Chart courtesy Perfection Division, Hupp Corp.*

Minneapolis-Honeywell Regulator Co.

In a typical new industrial building, the cost of owning and operating the building, including heating, is $1.92 per sq. ft. per year. Machinery and equipment, including depreciation, obsolescence, maintenance, and taxes, amounts to $7.05 per sq. ft. per year.

The largest single cost in this factory is that of wages and fringe benefits which is $36.10 per sq. ft. per year.

The additional cost of owning and operating a complete year-round air conditioning system which is operating 10 hours per day would cost only 46

(Please turn to page 43)

In this automated factory, ventilation poses problems of . . .

Process Air Handling At Ford Transmission Plant

by Eugene Carsey
Assistant Chief Engineer, Kirk & Blum Mfg. Co.,
and Lowell Shimp
Construction Project Engineer, Ford Motor Company

If you're turning to automation, you'll need to pay close attention to process air handling and ventilation. Details of air handling for tool grinding, automatic brushing, welding, heat treat blast, machine transfer and anodizing are given.

A SERIOUS INTERRUPTION in the fully automated production of transmissions at Ford Motor Co.'s modern plant at Sharonville, Ohio, could throw their complex car production program out of kilter.

For this reason, and because Ford engineers required as clean a plant atmosphere as practical for employee health and for product quality control purposes, air engineers have designed an elaborate ventilation and dust control system for this huge plant.

The plant has about 1,600,000 sq. ft. (about 37-acres), and employs some 3,500 people.

The high order of ambient air cleanliness demanded by Ford standards dictated the need for local exhaust and dust control at the source, as well as a separate and distinct installation of air replacement, amounting to about 2,750,000 cfm of outside air. *For a full discussion of the plant heating system, see page 27 of the April, 1959 issue of AIR ENGINEERING.*

This article will describe the more interesting of the great many dust, oil mist, fume, and particulate matter collection systems at this plant.

Certain basic engineering practice was adhered to throughout all of the installations to be described. Primarily, dust sources were each carefully studied and a design volume expressed in cfm was individually assigned.

Hood characteristic was next considered and entry coefficient with its corresponding velocity pressure loss selected. Using main, sub-main and branch velocity of 4000 fpm through 4500 fpm as design, total pressure was computed for each system. Summation of various line losses including hoods, elbows, fittings, traps, etc., was ascertained, with branch balancing accomplished using the square root of static pressure potential.

Where necessary, branch pressure correction was made by the simple expedient of hood pipe tapers or branch line diameter variation, considering branch pressure loss varying essentially as the fifth power exponent of pipe diameter.

Tool Grinding Ventilation

The tool grinding area is served by two complete ventilation systems, using local exhaust at all grinding wheels (Fig. 1A).

A unique feature of this installation is the use of small, series-staged collectors in the branch lines for the purpose of capturing diamond dust from diamond type grinding wheels. Dust is reclaimed, providing a monthly savings of $300 to $400.

The system is energized by dry centrifugal dust collectors, followed by aftercleaners. Flexibility is obtained by the system design, which permits operation of each system either individually or collectively.

The after-cleaners make use of oil washed fluid bed pads. Air cleaning is done by preliminary separation of contaminant by means of centrifugal force imparted to the solids by the centrifugal collector impeller. Precleaning and after-cleaning permit air to be safely returned to working areas. Discharge of all collectors is well below the M.A.C. limit.

Design velocities in both branches and mains is 4000 fpm. (Fig. 1.) System I has a volume of 9700 cfm at 8.9 in. inlet s.p. The centrifugal collector operates at 1230 rpm, requiring 38 shaft hp. System II has an air volume of 11,600 cfm at 8.3 in. inlet s.p., blower operates at 1310 rpm at 46 bhp.

Low loss fittings were used throughout, with fire and cleanout doors provided at strategic points throughout the mains.

Each diamond trap has a hand-operated valve to permit by-pass of air while trap, or small glass jar below centrifugal collector is being emptied of diamond dust at the individual machine.

Particulate size of collected dust is below 15 microns, with dust loadings about ¾ to one grain/cfm.

Both installations use balanced system design, in which essentially equal static pressures are maintained at all branch hood lines by tapered orifice connections from hoods.

Automatic Brushing Ventilation

Fig. 2 shows a typical automatic brushing operation. Five 12 in. diameter wire brushes, individually hooded, are served by separate exhaust lines. Note the rather unusual cluster of low loss (laminar flow) fittings above machine, permitting each branch pipe to have a section of flexible tubing and adjustable slip joint for necessary and convenient wheel adjustment.

This operation brushes particulate from metal parts, which are later to be machined to close tolerances Fig. 2A.

Note also that Fig. 2 shows a branch main with cap, for future use. Here the art of system balancing is applied by the simple means of providing an opening in the cap to permit enough air to enter system to maintain material handling velocities within the main.

Recovering Coolant

A compact system of underground coolant connections from the various machinery operations throughout the entire plant required consideration of a somewhat unusual application of mist, or mineral seal coolant control. These various coolant recovery systems terminated at several points, similar to the one shown in Fig. 3.

Here it was necessary to recover coolant by positive filtering methods, separating the valuable mineral seal oil from the metallic contaminant. A very fine airborne mist accompanied this operation and subsequently had to be controlled by means of exhaust, as shown in Fig. 3. A pre-cleaning centrifugal extractor was employed, making use of centrifugal force for initial deposit of the very light mists. This extractor was equipped with an interior tubular guard fabricated from four in. thick layer of copper wool, medium density, set in #18 gauge, ½ in. by 1 in. expanded metal.

Mists are subjected to centrifugal force for primary separation, followed by copper wool tubular guard and subsequently into the separate air filter section, located immediately at fan inlet.

Drainage is accomplished by gravity piping, protected by traps of sufficient depth to permit operation at 6 in. s.p., w.g. Thus, three separating phases were employed: centrifugal, primary and secondary mechanical.

An industrial type blower handles 3,850 cfm at 6 in. s.p. Both extractor or pre-cleaning centrifugal and secondary filter were mounted on a common

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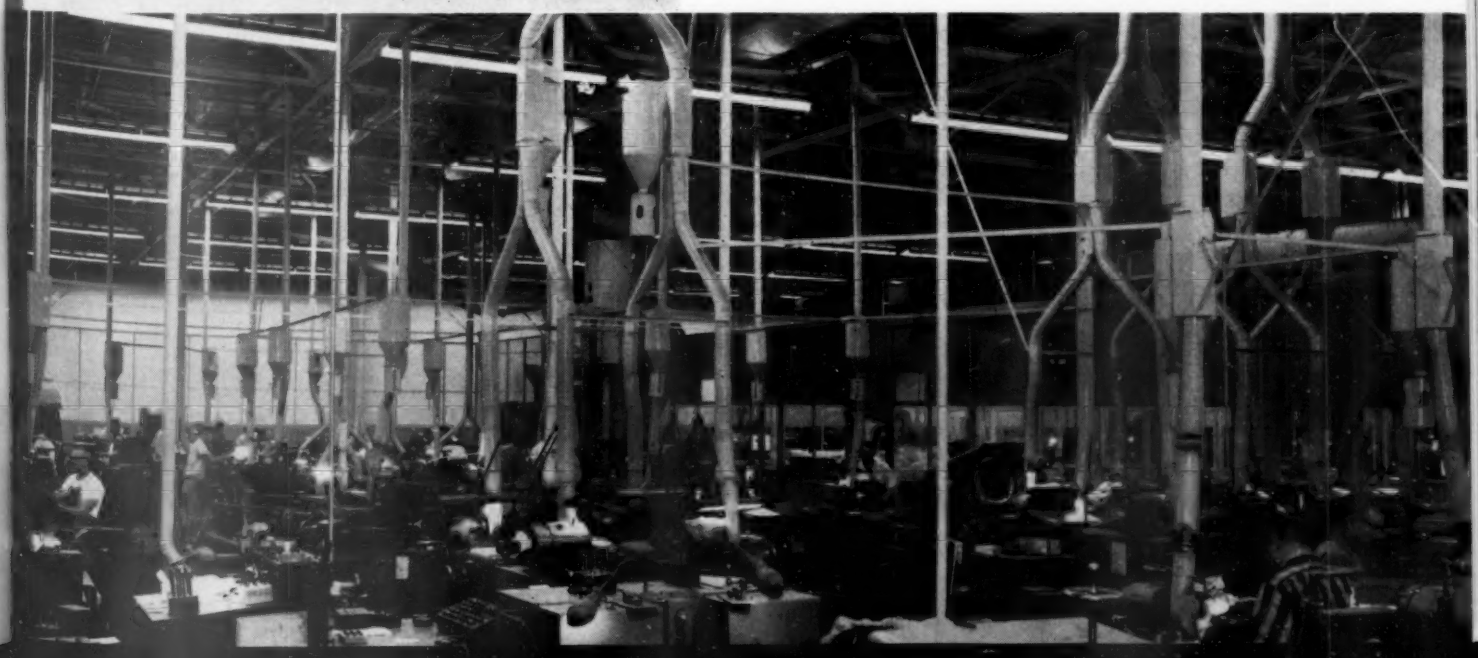


Fig. 1: ***Small series-staged collectors in branch lines capture diamond dust from grinding wheels.***

Fig. 1A: *Close-up of diamond tool grinding wheel. Note dust collector duct.*

(Continued from preceding page)

structural framework, suspended from overhead trusses. All recovered mists were drained back into floor pit.

Cleaned air is returned to working area at ceiling level.

This installation collects about 3 to 5 gallons of oil mist per 8 hour operating shift. This oil mist would otherwise condense on ceiling surfaces and trusses.

Welding Fumes

The installation shown in Fig. 4 was made for the purpose of controlling welding fumes. The system makes use of essentially a lateral cross draft application wherein welding fumes are taken into hoods located very close to the working area. Each hood is nine ft. long by two ft. two in. vertical opening. A total of 14,400 cfm at 3 in. s.p. was handled by a limit load arrangement class one, clockwise upblast fan providing 9800 cfm at each of these hoods. The resultant inlet velocity, with all three hoods in operation simultaneously, was 245 lineal fpm in-draft. Fumes are discharged through a vertical stack approximately 15 ft. high to outside atmosphere.

Welding bench was 9 ft. long by 5 ft. wide, hood being mounted directly to rear.

Actual application proved quite satisfactory in that the lateral cross draft arrangement permitted welding fumes to be drawn away from operator, below breathing level.

It was found experimentally, by slightly elevating the hood, that greater efficiency was obtained. Because this is a general welding shop, all types of welding – electric, arc, gas, acetylene, is done. All type welding rods are employed.

Fan and motor are mounted on a common platform suspended from roof trusses. Provision was made originally for addition of a future hood, which was later installed.

This is one of the few installations that did not return air to working area.

Automatic progressive welding operations were individually exhausted by means of fan handling 3500 cfm at 1½ in. s.p. Fan, truss mounted above head, discharged collected fumes to outside atmosphere through a 15 ft. stack. This installation was typical of several systems.

Heat Treat Blast Cleaning

This installation was a progressive system made for the very important heat treat area blast cleaning department. This operation is served by ten shot blast cabinets for cleaning operation. The department operates on a 24-hr. schedule and the dust control installation makes use of by-pass register grille inlets at each cabinet, thus insuring proper air volume from the cabinets, at the same time maintaining material handling velocity at essentially 4,000 fpm within the branches and lines leading from the various machines.

Subsequent pitot tube reading established volumes and velocities within 10 per cent of design. The accurate control was attributed to the by-pass register collars, furnished in branches near cabinets.

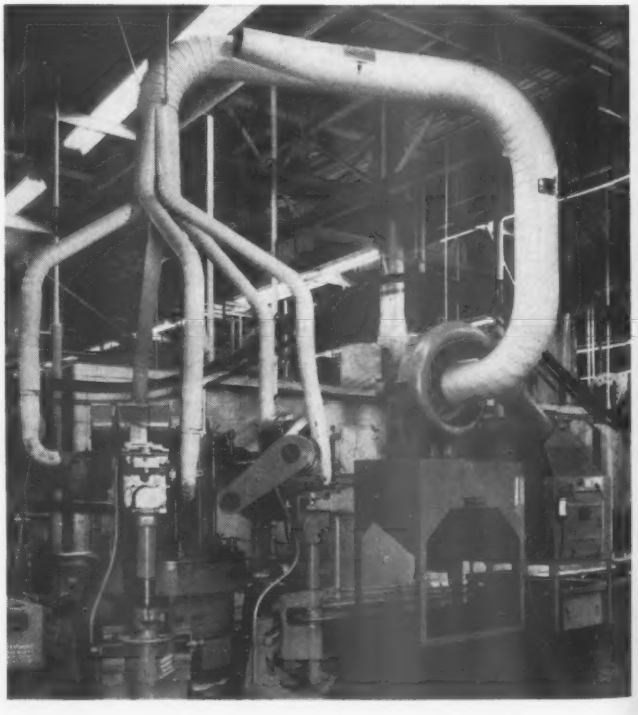
The installation makes use of an intermittent type dust collector with fan handling 16,000 cfm at 9½ in. s.p. All air was returned to the working area. A small supplementary tube dust collector with 5 hp. fan and motor served one machine.

Chemical Laboratory

The chemical laboratory fume exhaust system was designed to serve three tables. Stainless steel ductwork was used for corrosion resistant purposes. The usual acid fumes are exhausted such as nitric, sulphuric, hydrofluoric, etc. The system was designed to handle 6,000 cfm at 2 in. s.p.

Fan was protected by bitumastic paint. Drain connections were provided in fan scroll and air was discharged to outside atmosphere. Since the exhaust fan unit was located outside chemical laboratory

Fig. 2: *Automatic brushing ventilation. Each of five 12-in. dia. wire brushes are served by separate exhaust lines. Note cluster of low loss fittings above machine.*



proper, ductwork necessarily passed through a curtain wall. Fusible link and 10 gauge stainless steel fire dampers were used for protection.

There were many stacks involved in the various dust and fume control exhaust systems. The roof, steel decking type with insulation and gravel topping, had to be cut in numerous locations, permitting passage of various stacks. Special flashings were used.

Machine Transfer Point Ventilation

Heald transfer point required dust control, and a rather unique application was used here embodying localized hooding. Energizing equipment is a centrifugal collector followed by secondary oil wash type collector. This particular type arrest uses a long sweep inlet elbow at centrifugal collector, thus functioning as a pre-cleaner prior to entry into the centrifugal collector itself, which served as a secondary cleaner followed by a tertiary oil mist separator. Air was returned to working area.

Anodizing Machine

An anodizing machine is served by two complete systems (Fig. 5). The purpose of the two systems is to separate acid fume mist from the alkaline solution fume mist. System No. 1, handling acid, was equipped throughout with No. 16 gauge monel metal piping hoods and connections. System No. 2 made use of 14 gauge black steel piping painted inside with corrosion resistant paint.

System No. 1 fan handles 4,500 cfm at 2 in. s.p. System No. 2 was similarly served excepting fan handled 5,500 cfm. All fumes are discharged directly to outside atmosphere.

Small Parts Washing

57 complete exhaust installations are provided for small parts washers. Each washer has its individual exhaust stack, and fan discharging various volumes ranging from 3,000 cfm to 5,000 cfm per washer, directly to outside atmosphere. Stacks were designed on the basic concept of controlled expansion for limited moisture separation.

Woodworking

A rather interesting and somewhat unusual shavings and dust collecting installation was provided for the woodworking department of this vast plant (Fig. 6). Eight woodworking machines; a belt sander, 24 in. power joiner, saw, bandsaw, 15 in. sander, 24 in. power planer, 10 in. circular saw and radius saw; were served by this system. The system is energized by a fan handling 6,250 cfm at 7 in. s.p. A centrifugal size collector, floor mounted with dust receptacle is

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Fig. 4: *Welding bench ventilation system. System uses lateral cross draft ventilation. Hoods are 9 ft. long by 2 ft., 2 in. vertical opening, handling 9800 cfm/hood @ 245 fpm.*

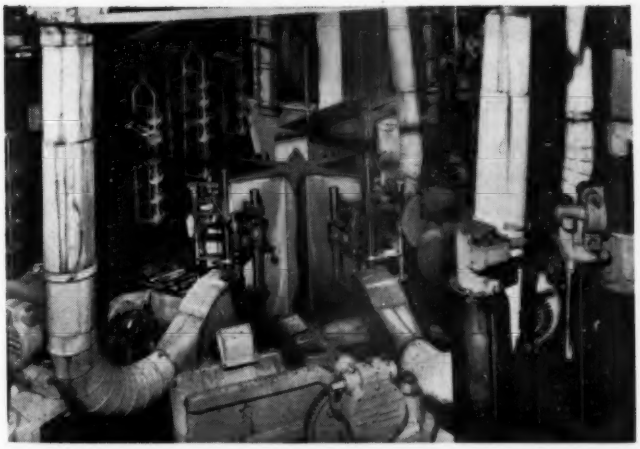


Fig. 2A: *Close-up of automatic brushing machine ventilation set-up. Each brush has own exhaust hood.*

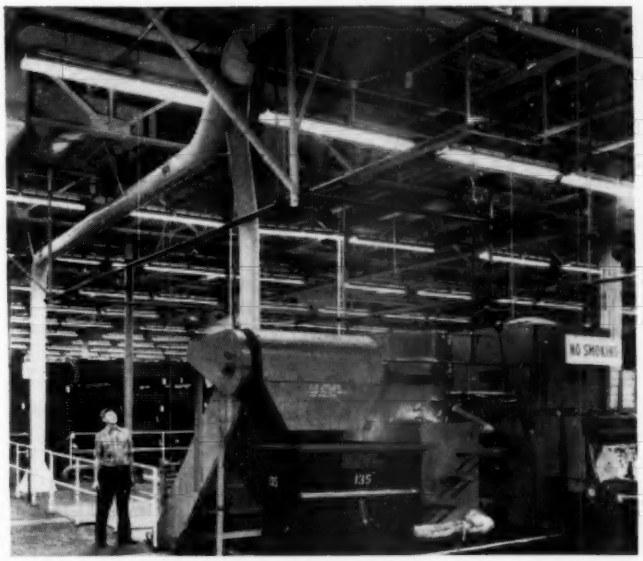
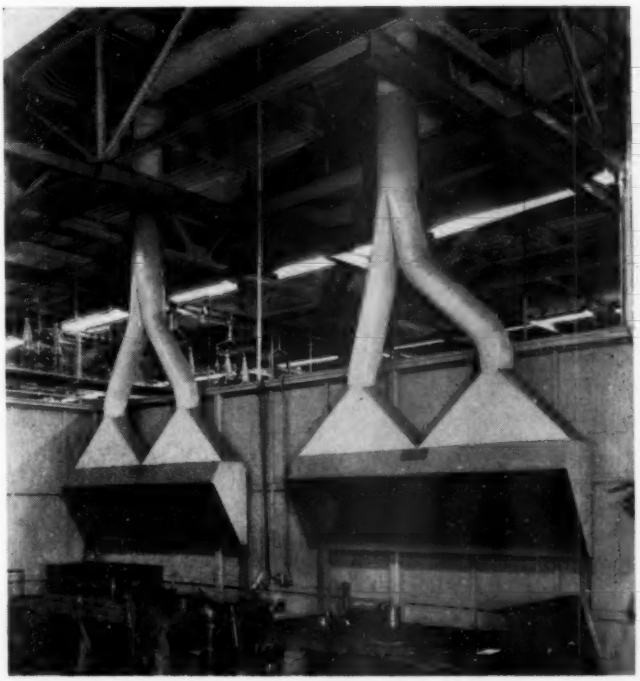


Fig. 3: *Recovering coolant is an important operation at this plant, and it's done via underground connections from various machines. Coolant ventilation keeps oil mist from plant area.*



Ventilation at Ford

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provided with vent outlet piped to outside atmosphere.

The power plant, a separate building in itself, is capable of producing 250,000 pounds of steam/hour. Low pressure steam for plant processing and heating also became subject to dust control consideration.

Due to the close proximity of neighbors to the plant and the plant itself to power house, consideration is given to fly-ash control.

A complete system of fly-ash re-injection was used whereby the fly-ash was not only controlled but reburned for increased boiler efficiency due to the high carbon content involved.

There are three boilers involved.

Air Quality Test

To actually test the quality of air within the plant during actual operation a "whiteness test" was recently made whereby a white cloth was placed over a limited area of the plant and compared by reflection prior to and following a predetermined length of operation.

It was found that the plant was operating under optimum cleanliness. Although this test was not made under the direction of the National Bureau of Standards, it may be noted that a similarity in procedure was followed, in that the degree of contamination was considered on a reflectometer basis. ▲▲

CREDITS

Designing engineer, installation fabricator and erector: *The Kirk & Blum Mfg. Co.*

Fans: *Buffalo Forge Co.*

Dust Filters, Individual Blast Cleaning: *Wheelabrator Corp.*

Collectors, cutter grind dept.: *American Air Filter Co.*

Mineral Seal Mist Collection: *The Kirk & Blum Mfg. Co.*

Power plant fly-ash collector: *Green Fuel Economizer Co.*

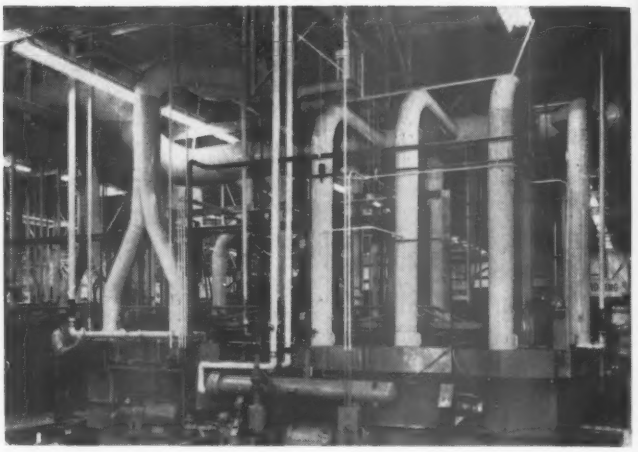

Fig. 5: *Anodizing machine ventilation separates acid fume mist from alkaline solution fume mist by use of two separate ventilation systems.*

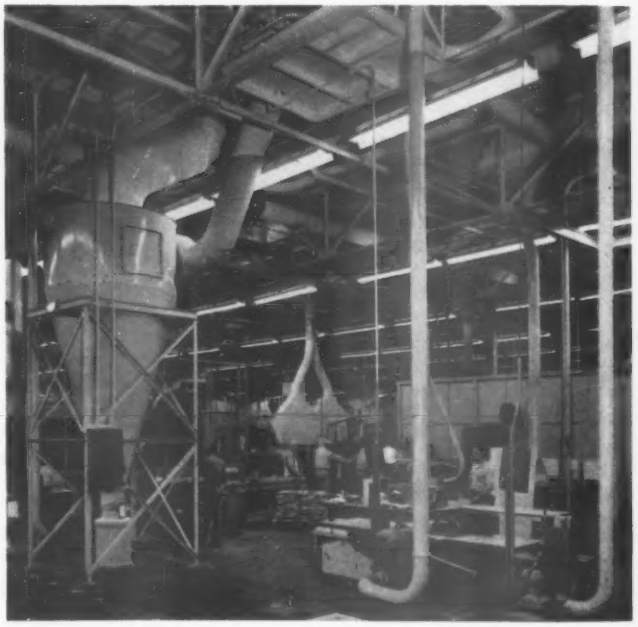

Fig. 6: *Woodworking dust collection is handled by a centrifugal collector, energized by fan handling 6250 cfm at 7-in. s.p.*

Imagination Please!

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Consulting engineer Meckler tells . . .

How To Cut Costs By Integrating Building And Systems Design

Part I

Specific suggestions are given in this article on integrating building design with the mechanical system design and equipment.

by Gershon Meckler*
Meckler Engineering, Consulting Engineers, Toledo, Ohio

THE MECHANICAL and electrical equipment needed to make modern buildings livable and economically feasible, costs from 25 to 40% of the total building construction cost. Consequently, under varying present and future conditions, the design of the mechanical plant, space requirements, and proper environmental controls must receive full consideration in the overall building design. The concept of the totally integrated building, the marriage of the environment with the structure, must be recognized as an important fundamental design principle. For example. . . .

New levels of illumination have created a challenging problem for the architect and engineer. The trend in lighting for buildings toward higher levels now have a pronounced effect on thermal requirements of the building structure.

Studies indicate that in an office building provided with 100 foot candles of general illumination, the lighting load accounts for approximately 42 percent of the total air conditioning requirements. If the foot candle level is increased to 400 foot candles, the lighting accounts for approximately 72 percent of the load.

Conventional methods of building design to satisfy current occupancy needs require the use of extensive space for ductwork, mechanical and electrical equipment. Considerable savings in building volume can be gained by integrating the structure with the environment. It is for this reason that the various systems within the building (mechanical, electrical, structural) must be designed so that they function as an integral part of each other.

Only by the integration of building structure, lighting, heating, cooling, ventilation, air cleaning and acoustics will be following be done:

- Maintain optimum comfort.
- Provide architectural freedom of design—complete flexibility.
- Increase availability of building floor area by as much as 50 percent.
- Reduce cubage of building.
- Satisfy the demands of higher lighting levels and electronic equipment.
- Reduce total first cost of building by as much as 20 percent.
- Reduce operating cost of air conditioning system, electrical system and building maintenance by as much as 35 percent.

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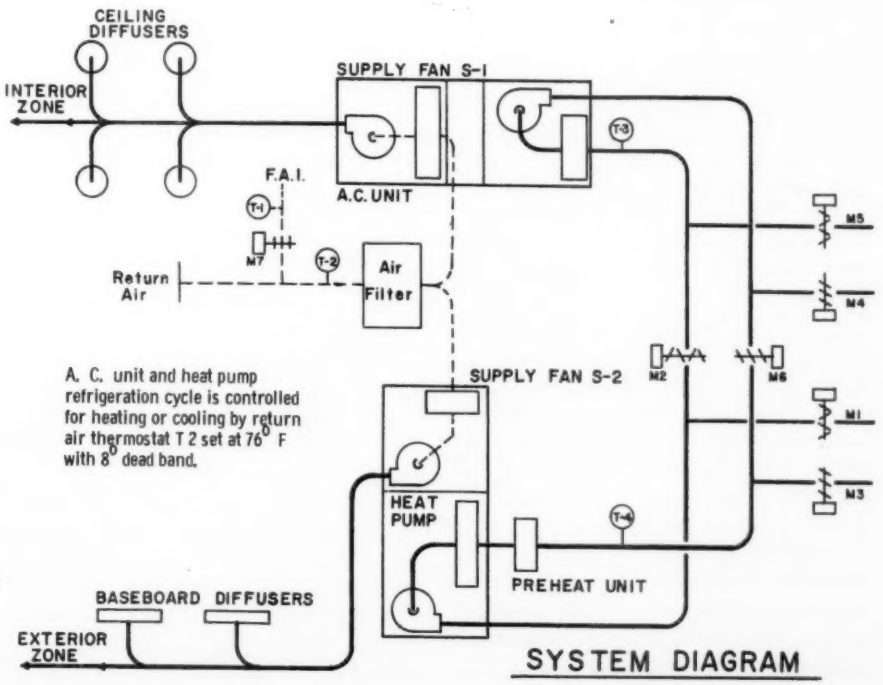

Fig. 1: *Right, Telephone and Communications Building, U.S. Air Force Base, Bellefontaine, Ohio. Heat pump and air conditioner are integrated to supply total cooling capacity during summer operation.*

*Mr. Meckler holds a degree in engineering physics from Pennsylvania State University and has done advanced engineering work at Newark College of Engineering and at Columbia University. He was a senior project engineer for Voorhees, Walker, Smith, Smith and Haynes, and a research physicist for the Signal Corps Engineering Laboratories. He is a registered professional engineer in Ohio, Indiana, Michigan, W.Va., and Penn. He is the owner of Meckler Engineering which he established in 1957 and which has done numerous laboratory, hospital and telephone buildings.

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The use of system design as a practical technique for achieving total integration of environment with structure is a significant break-through in architectural engineering technology. The creation of total environment can only be achieved through the integration of the mechanical, electrical, and structural systems. No longer can these systems be considered independent of each other. The selection and design of each system must be developed simultaneously.

The interaction of building systems requires that successful building products which serve as components of building systems are designed and developed as a function of the system design. Therefore, a building product development should be approached as a function of integrated systems.

Building Integration

The significant consequence of building integration is the utilization of architectural building products to do as many jobs as possible. Building systems must permit architectural products to serve a dual purpose; architectural and structural building products can then become available as components of the mechanical and electrical systems.

Building integration may be static and/or dynamic. By *static* integration I mean that building system components are designed to be physically integral with each other without effecting their related system energy requirements. *Dynamic* integration, however, can be achieved by the design of dual purpose products which are common to two or more building systems, permitting the direct interaction of system energies in such a way as to increase the efficiency and/or reduce the net energy requirements of the integrated building systems. Integrated design is illustrated in the following examples.

The first example is a system design which illustrates mechanical system integration only. The second example illustrates the integration of the building structural, electrical, and mechanical systems.

Integration of Mechanical System—Example I

The integration of components within a mechanical system permits the utilization of available energy by redistribution of heat from the occupied space. The mechanical system is designed so that an air conditioner and heat pump function as components of an integrated mechanical system, capable of instant response to variations in the thermal load requirements of occupancy and electronic equipment.

One of the buildings we will use to illustrate the need for integration of architectural design with mechanical system design, is the Telephone Communications Building, U.S. Air Force Base at Bellefontaine, Ohio.

This building contains approximately 1300 sq. ft. of floor area and houses electronic equipment requiring constant year-round temperature control. Electronic equipment provides heat gains to the building interior during all seasons of the year. During the winter, depending on the outside air temperature, the equipment heat gain may be such that cooling is required to maintain the proper inside temperature. This condition can vary throughout a day, from heating to cooling and reverse, several times during a 24-hour period. Since the building is generally unattended, a completely automatic system is required. A schematic diagram of the system is shown in Figure 1.

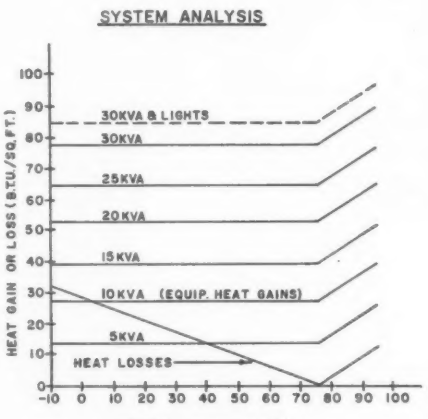

Fig. 2: *Package heat pump used for exterior zone and air cooled air conditioner package unit for interior zone. Interior zone handles equipment cooling, exterior zone cools or heats as required.*

The heat pump and air conditioner are integrated to supply the total cooling capacity during summer operation. Cooling capacity for equipment heat gains is provided by the interior zone air conditioner. The exterior zone heat pump and the interior zone air conditioner are interconnected on the air supply side. Equipment heat release is collected by the air conditioner, which transfers this heat through the exterior zone heat pump to the perimeter of the building to counteract transmission losses. The air condensers of both units are interconnected to permit winter operation of each at efficient temperature levels.

On a predetermined rise in space temperature, first interior then exterior compression cooling is staged. On a corresponding drop in space temperature, the exterior heat pump supplies single stage compression heating. Both supply air fans operate at all times, with part of the total air circulated supplied through the heat pump to the perimeter area baseboard diffusers, and part through the air conditioner to the interior overhead, ceiling diffusers. Thus, the system can instantly supply cold or hot air, or redistribute hot air from interior to perimeter, depending upon the particular net space demand.

Load Analysis

A graphical analysis of the building loads . . . from which the selection of equipment, arrangement of zones, and staging of the package heat pump and air conditioner was determined . . . is illustrated in Figure 2. The building requires a maximum cooling capacity of 96 Btuh/sq.ft. at a maximum heating capacity of 32 Btuh/sq.ft.

The need for a system capable of rapid load reversal is evident in Figure 2. For example, at 10°F. outside temperature, the building requires 25 Btuh/sq.ft. of heating If 9 kva of equipment is on the line, redistribution of the corresponding heat release just balances the building heat losses. If an additional 3 kva comes on the line to make a total of 12 kva connected load, the first stage of compression cooling is activated at the interior air conditioner. But if it is an additional 10 kva that comes on the line, to make a total of 19 kva connected load, the second stage of compression cooling is activated at the exterior heat pump. If 6 kva of equipment is suddenly disconnected, reducing the connected load to 3 kva, the first stage of compression heating is activated.

Mechanical redistribution of thermal energy between the in-

terior and exterior areas coupled with single stage heating and two stage cooling permits this mechanically integrated system to follow the instantaneous building thermal load at sizable savings in year-round operating cost.

Example II

In this example, thermal load results from operation of the space lighting (a building system). The integration of mechanical-electrical-structural systems permits efficient utilization of the available heat from the lighting system.

Simultaneous heat losses from building perimeter areas and gains from lighting provided the opportunity to utilize a combination of heat pumps and recessed lighting in an air plenum system. Heat pump equipment staged and zoned in conjunction with atmospheric cooling, and arranged in a manner which utilizes the heat available from the lighting system, serves as a source of heat from building perimeter areas.

When the outside air rises above 36°F., atmospheric cooling provides complete removal of lighting heat. During cold weather, this system inherently removes excess heat from one area and transfers it to another area requiring heat. During summer operation, 5 to 7 percent of the total heat release of lights is exhausted outside, reducing the installed cooling equipment.

Figure 3 shows an isometric of the main floor ceiling and roof plan of the show rooms, containing 30,000 sq. ft. of conditioned space on two floors. This building functions primarily as a display area for merchandise and requires a daytime incandescent lighting load of 50 foot candles. Seven hundred incandescent light fixtures were installed approximately 6 ft on center throughout the entire store. Each fixture contains a 150 watt floor lamp. The building is insulated and of solid masonry construction.

Referring to Figure 3, the hung ceiling serves as a common return air plenum and housing for overhead recessed lighting for both interior and perimeter zones. The interior zone heat pumps provide daytime compression refrigeration with outside air temperatures above 55°F. and switch to atmospheric cooling below 55°F. The perimeter zone heat pumps provide compression heating or cooling as a source of heat for the perimeter zone heat pumps when the interior zone is on atmospheric cooling. During winter night set-back, both interior and perimeter zone heat pumps switch to compression heating to maintain 65°F. temperature.

Zone Losses

Figures 4 and 5 summarize the separate heat gain and loss requirements for the main floor interior and perimeter zones, as a function of outside temperatures. Analysis of these curves provides an explanation of heat redistribution and serves as a basis for justification, selection and arrangement of heat pump equipment.

For example, assume the system is operating with an outdoor condition of 20°F. temperature. The perimeter zone experiences a 3.5 Btuh/sq.ft. net heat loss, while the interior zone shows a 5.5 Btuh/sq. ft. simultaneous net heat gain. Providing a common floor air return, the engineer need add only 1.5 instead of 3.5 Btuh/sq.ft. net heating to the air supplying the perimeter zone, and only 2 instead of 5.5 Btuh/sq.ft. net cooling to the air supplying the interior zone.

Heat redistribution, in effect, reduces the interior zone cooling load by 63 percent and the perimeter zone heating load by 43 percent. When the outside air temperature rises above 36°F., reversal of thermal load takes place and the perimeter zone calls for cooling. The interior zone calls for cooling at all times except winter nights.

This system incorporates several desirable operating features. Ex-

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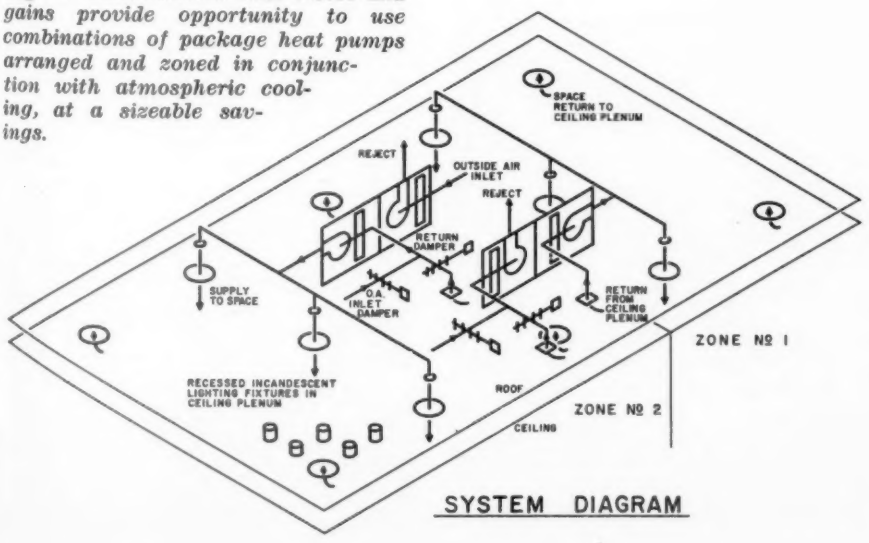

Fig. 3: *Simultaneous heat losses and gains provide opportunity to use combinations of package heat pumps arranged and zoned in conjunction with atmospheric cooling, at a sizeable savings.*

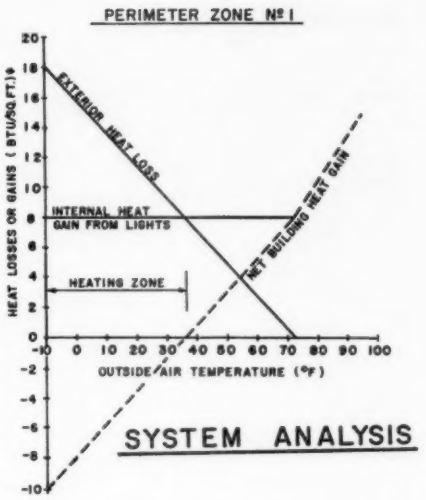

Fig. 4: *Above, winter operation, heat pumps heat during night or below 36F outside air during day. Above 36F, heat pumps provide refrigeration cooling. Summer, heat pumps provide refrigeration cooling. Perimeter zone No. 1.*

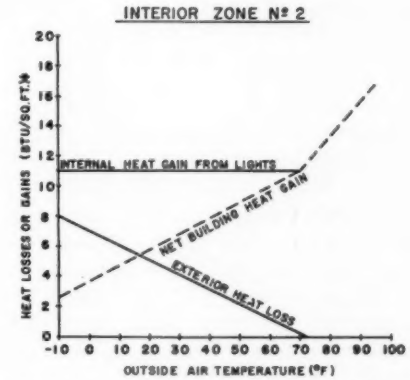
INTERIOR ZONE Nº 2
HEAT LOSSES OR GAINS (BTU/SQ.FT.)
INTERNAL HEAT GAIN FROM LIGHTS
NET BUILDING HEAT GAIN
EXTERIOR HEAT LOSS
OUTSIDE AIR TEMPERATURE (°F)

Fig. 5: *For interior zone No. 2, package heat pumps heat during night only, during winter. Atmospheric cooling is provided during day. On summer cycle, heat pumps provide refrigeration cooling.*

Factors Governing . . .

Size and Space Needs Of Electrostatic Precipitators

Whether you are planning purchase of a precipitator for air cleaning, product recovery or both, you'll need to know how air cleaning performance specs affect size of unit.

by E. P. Stastny, *Project Engineer**
Industrial Gas Cleaning Department
Koppers Company, Inc.

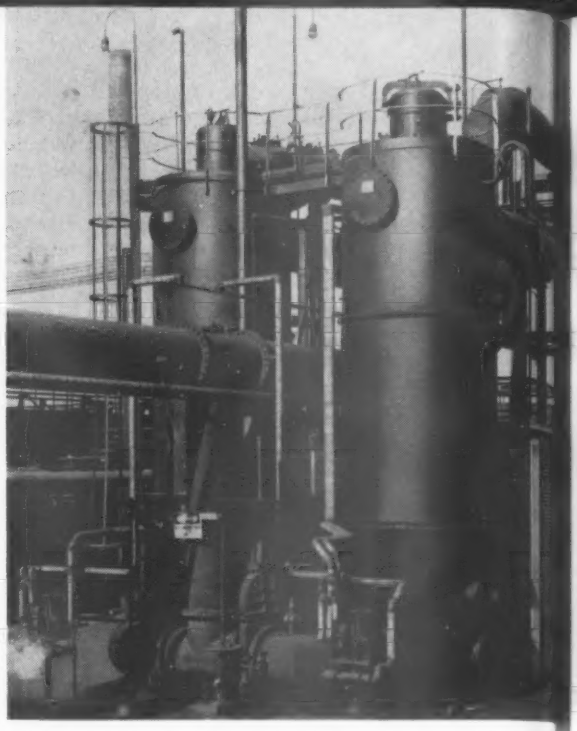

Fig. 2: *Above, a precipitator used for the removal of tar and moisture from gases emanating from a coke oven battery found in steel mills.*

AN ELECTROSTATIC PRECIPITATOR represents a large capital expenditure. A good specification and a well thought out offering, reflecting the most economical unit dollar and size wise, can be made in two months. It takes six months to a year to fabricate and erect the unit and with minimum maintenance, the precipitator is expected to have an industrial life of 15 to 25 years. To assure the buyer of purchasing long range optimum performance, an additional week or two of pre-contact discussion with suppliers regarding their individual proposals should be planned.

The most important consideration in the sizing of an electrostatic precipitator is the desired residual requirement, which would fix the efficiency needed. Including the residual requirement, a set of design conditions would contain gas volume, temperature, pressure, dust loading, and dust characteristics (bulk resistivity and particle size).

Figure 1 illustrates the relationship of efficiency versus size for a fixed set of conditions. Note that size of precipitator increases proportionately up to the low 90 percentages, but efficiencies of higher value require size increases of accelerating proportions as the higher efficiencies are approached.

To illustrate the extremes in physical size of precipitators, observe Figures 2 and 3, showing typical commercial applications. Each unit shown in Figure 2 is utilized for removing tar and moisture from gases emanating from a coke oven battery found in steel mills. Dimensionally, each unit is 8 feet in diameter by 20 feet high. It is designed to clean 8,000 cfm of gas at an efficiency of 98 percent. Figure 3 is typical of equipment designed for 98 percent efficiency when handling a gas volume of 1,050,000 cfm. This 135 foot wide, 50 foot high, and 29 foot long precipitator is used to remove fly ash from pulverized coal fired boiler combustion gases.

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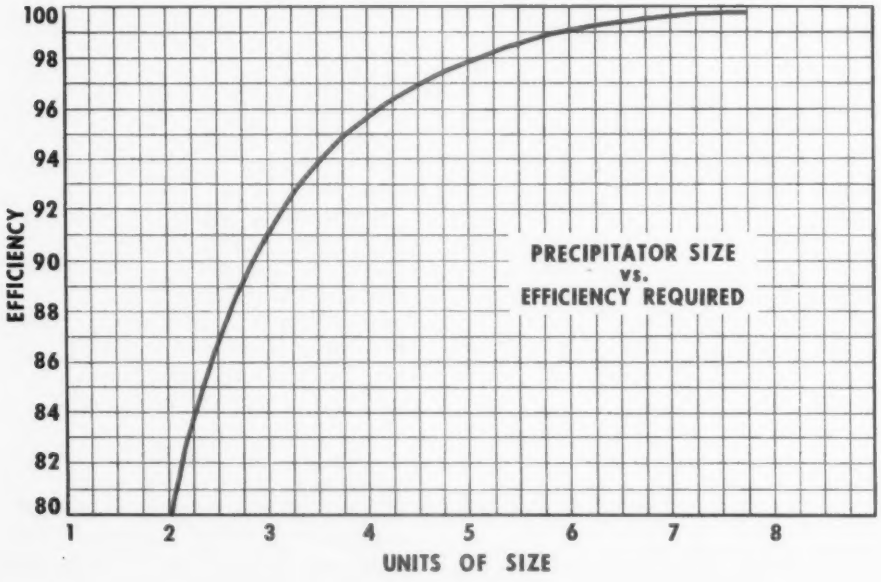

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Fig. 1: *Left, a chart to show the relationship of precipitator efficency versus the size for a fixed set of conditions.*

**Mr. E. P. Stastny graduated from Drexel Institute of Technology with a B. S. Degree in Mechanical Engineering. He worked with Koppers while at school and continued after graduation to progress to his present position of Chief Project Engineer in the Industrial Gas Cleaning Department of Koppers Company, Inc.*

Precipitator Sizing

(Continued from page 34)

Appreciating that efficiency governs the size of the precipitator and, therefore, its cost, it becomes necessary to explore the factors that are used to determine what efficiency should be specified. Precipitator usage falls into three basic categories, either separately or in combination. These are:

1. **Recovery of valuable dusts**
2. **Cleaning of usable gases**
3. **Nuisance abatement**

In the first category, recovery of valuable dusts, efficiency of the precipitator is viewed from an economic aspect. An efficiency is frequently specified where value of recovered product will offset cost of the equipment over a predetermined period of time, say two or three years. Or, the efficiency is specified to maintain a product balance so that make-up requirements will not exceed a fixed amount. Figure 4 illustrates a precipitator utilized in the production of pulp and paper. This unit follows the recovery boiler, which uses as a fuel waste liquors high in valuable chemical content. The ash from this boiler consists of approximately 95 percent sodium sulphate, and the precipitator will remove a specified percentage of this carryover, depending on design requirements. An average precipitator following a recovery boiler will reclaim about $1,200 per day of reuseable ash.

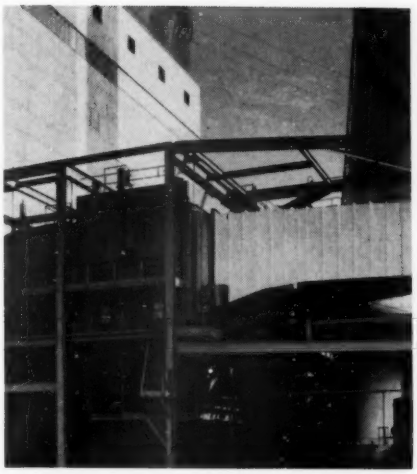

Fig. 3: *Above, a 135 ft. wide, 50 ft. high and 39 ft. long precipitator used to remove fly ash from pulverized coal fired boiler combustion gases with an efficiency of 98 percent.*

Fig. 4: *Above, a precipitator used in the production of pulp and paper. This unit follows the recovery boiler, which uses as a fuel waste liquors high in valuable chemical content.*

Other examples of precipitator application which fall in this category are: recovery of reuseable cement dusts from rotary kilns, Figure 5; recovery of valuable nonferrous metallics from numerous refining processes; recovery of reuseable rock product dust (such as gypsum) from process equipment.

In the second category, cleaning of useable gases, efficiency of the precipitator is dependent upon end use of the gas. As an example, in steel mills the iron producing blast furnace produces exit gas sufficiently high in CO to be used as a fuel. The gas, however, contains dust in the form of metallic oxides, etc. which must be removed to reduce or eliminate pluggage and/or abrasive wear of the firing nozzles. In a steel mill this gas may be used for preheating stoves ahead of the blast furnace, underfiring coke oven batteries, fuel for powerhouse steam producing boilers, and as fuel for gas turbines. Each application requires a different type firing nozzle, each nozzle requires a specific degree of cleaned gas for its proper operation. Figure 6 illustrates a blast furnace gas cleaning electrostatic precipitator installation found in steel mills. Other examples of precipitator applications in this category are: coke oven gas detarrers, Figure 2;

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Fig. 6: *Below, a blast furnace gas cleaning precipitator.*

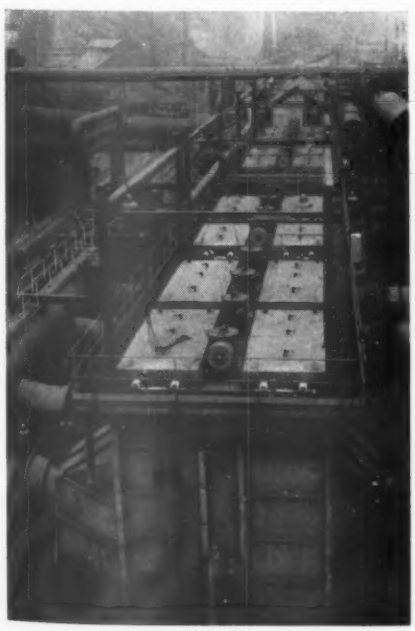
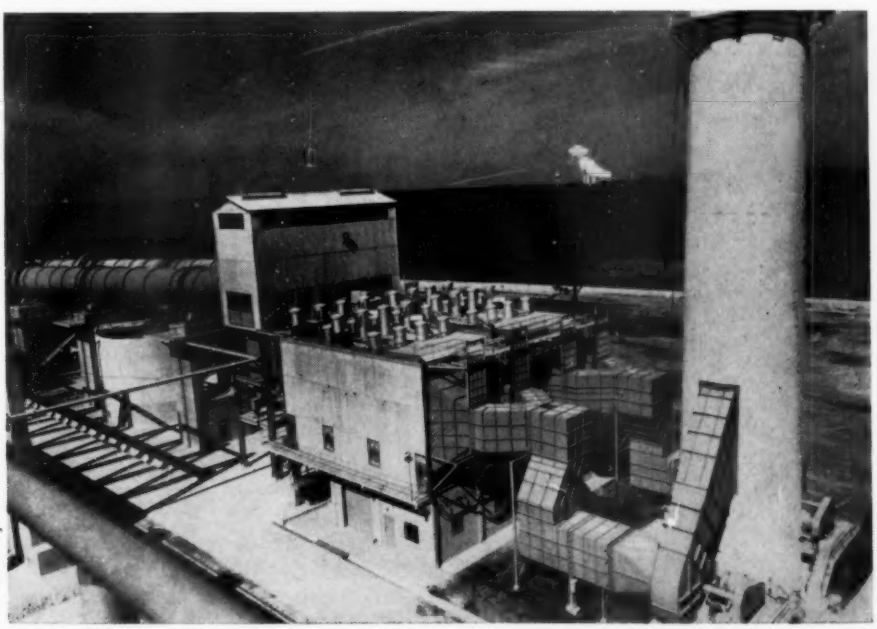


Fig. 5: *Below, a precipitator used in the recovery of reuseable cement dusts from rotary kilns.*



Precipitator Sizing

(Continued from preceding page)

and sulphuric acid mist recovery, Figure 7.

In the third category, nuisance abatement, the need for gas cleaning equipment is determined by local laws and/or desire of the buyer to achieve neighborhood good will. Competition among equipment suppliers is keen because the buyer is seeking equipment at minimum cost since the recovered ash has no, or very little, value. Therefore, when electrostatic precipitators are used, it's because they offer the most for the money being spent, or because, other types of gas cleaners cannot meet the specified requirements.

Efficiency Requirements

Many cities and states have strictly enforced laws which prescribe the amount of stack ash emission allowed based on quantity of gas emitted, or process weights of solid materials being used. This type law would fix the efficiency requirement of the precipitator. In many instances the legal emission still leaves a dirty looking stack; and much to the buyer's consternation, nuisance complaints still come in.

Industries are recognizing this possibility more and more, consequently they buy equipment which reduce emissions to a tolerable visual limit. The trend in recent air pollution legislation is to establish visual limitations; therefore these buyers find their foresight definitely to their benefit.

Many industries, particularly the utilities, had long ago recognized the value of public good will, and without legal pressures, provided electrostatic precipitators of high efficiency with many of their new plants. Figure 3 illustrates such an installation, used for fly ash recovery from pulverized coal fired boiler flue gases. Other examples of precipitator application in the category of nuisance abatement are: removal of dusts from open hearth furnace gases, Fig. 8; and removal of iron ore sinter dust from sinter machine exhaust gases, Fig. 9.

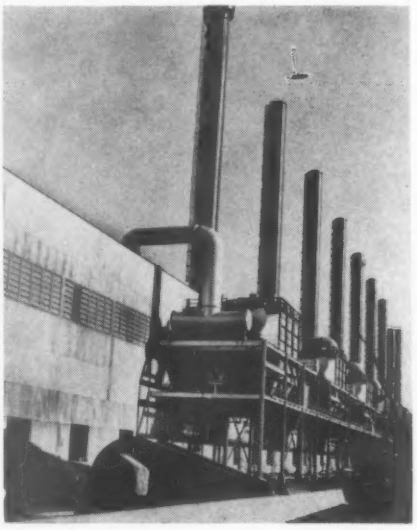


Fig. 7: *Above, precipitators used in the recovery of sulphuric acid mist from various chemical processes.*

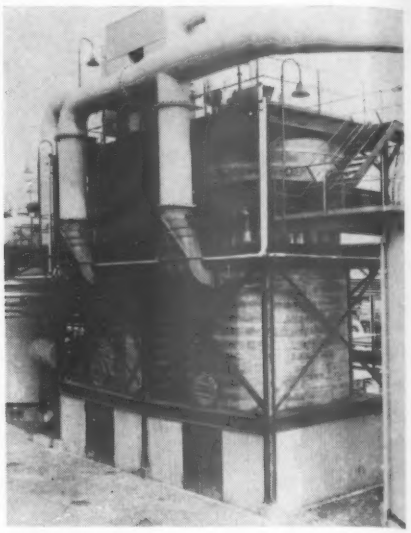


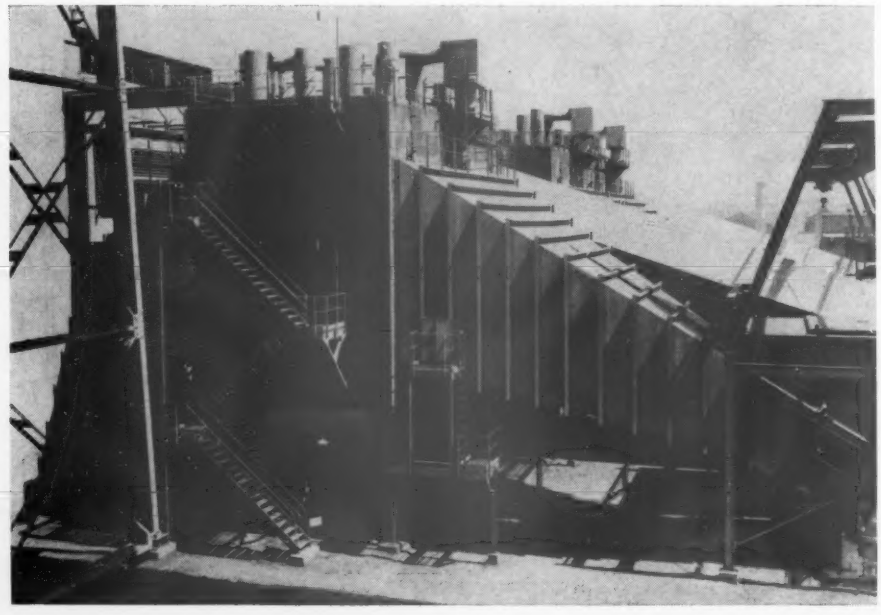
Fig. 8: *Above, a precipitator for the removal of dusts from open hearth furnace gases.*

Having established an efficiency requirement, the buyer is ready for suppliers' quotations. The suppliers' quotations are determined by two factors. First many suppliers of standardized designs cut cost to have an edge over other bidders. Secondly, the suppliers' experience and background will be a help in the choice and number of auxiliary components. Because of these factors, it becomes mandatory for the buyer to hold technical discussion with each supplier and weigh his technical presentation against what other suppliers have offered.

Size Possibilities

For any given set of conditions a supplier has various alternate size possibilities which must be evaluated. Limited space conditions can be overcome through the use of alternate collecting plate lengths and heights. Maximum utilization of the capacity of power equipment can be obtained through variations in size of discharge electrode assemblies. Efficiency gains through electrical sectionalization must be weighed against cost of additional power units. Size reduction through operating precipitator at more efficient temperature levels must be weighed against heat losses and/or cost and operation of cooling equipment. Consideration of auxiliary equipment, such as dust removal system being used, may influence the arrangement of the precipitator. These, and other considerations, determine what the individual supplier will offer. ▲▲

Fig. 9: *Below, a precipitator used for the removal of iron ore sinter dust from sinter machine exhaust gases.*



NEW IDEAS IN VENTILATION . . .

Ventilation of free silica in the buffing and polishing industry, control of radioactive materials in chemical laboratories, dust control in mines, quarries and construction.

by James Barrett
Ventilation Engineer
Occupational Health Division
Michigan State Dept. Of Health

INDICATIONS SHOW that the complete hazard of the buffing and polishing industry, may not yet be evaluated; we are finding free silica in the common buffing and polishing compounds and cases of silicosis are now being reported. We find that the ventilation is usually inadequate, especially with automatic polishing and buffing equipment.

Fig. 1 illustrates a new installation at the Flint, Michigan plant of Ternstedt Division of General Motors Corporation. This is a four-wheel automatic straight line buffer. Each wheel is 17 in. diameter by 24 in. long and is powered individually. These are sisal wheels buffing cold rolled steel trim before plating. Some of the details of the installation are obvious. Two access doors, approximately 25 in. square are provided on each side of the enclosure; these are large enough for easy replacement of buffs.

In normal operation they are closed. The bottom of the enclosure is hopper shaped and the 6000 cfm exhaust is drawn through this hopper through a 15 x 15 in. duct and then upwards through a 16 in. round duct to the dust collecting system. A cleanout door is provided at the bottom to remove plugged material. The buffing compound used is a liquid spray; spray intervals are timed and the spray pattern is directed at the wheels.

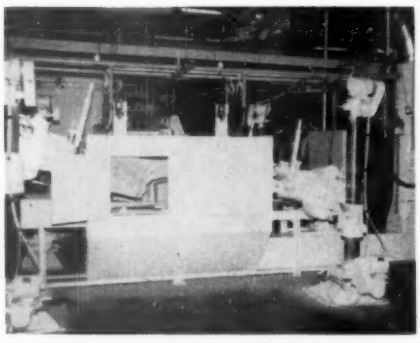


Fig. 1: Right, an individually powered four-wheel automatic straight line buffer. Each wheel is 17 in. wide by 24 in. long.

Fig. 2 shows an end view of the same type of enclosure which has been operating for the past three months. You will note the lack of dirt and debris outside of the box and you will note also the baffling which is provided at the ends. This is made up of used belting strips and they are profiled originally to fit the conveyor quite closely.

General reports of this installation are most satisfactory. The area is kept clean, the enclosure is easy to maintain and there has been no difficulty with setup, buff replacement and adjustment. As a matter of fact both of these machines are equipped with completely automatic wheel adjustment. The operator

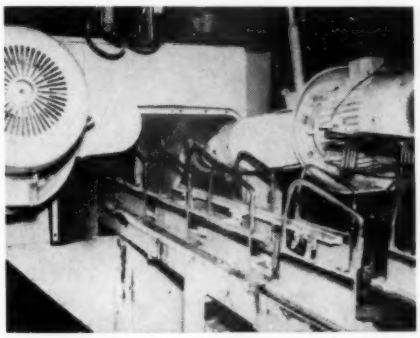


Fig. 2: Right, the end view of a four-wheel automatic straight line buffer.

stands before a large control panel with an ammeter for each of the driving motors. To allow for buff wear the operator has automatic motor-operated controls which adjust the buff closer to the work.

Fig. 3 illustrates a circular three-wheel automatic buffer for the polishing of instrument control knobs. Here again the wheels are 17 in. diameter and the widths vary from 1 in. to 3 in. You will note that the hoods are oversized to allow for wear and changes in set up. Note the baffling around the driving shafts and the close baffling at the turn table. Liquid spray compound is used.

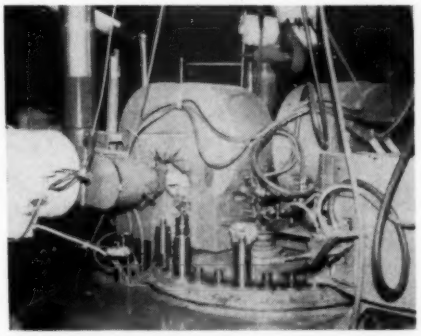


Fig. 3: Right, a circular three-wheel automatic buffer for polishing instrument control knobs.

The branch ducts from the hoods are 8 in. diameter and duct velocities range from 4200–5000 fpm for an average exhaust of 1630 cfm from each wheel. This does an adequate job; there is some escape of com-

(Please turn to following page)

(Continued from preceding page)

pound at the shaft when the baffles are not kept tight but dust control is excellent and does not interfere with other operations in the vicinity.

Fig. 4 illustrates the beginning of a full enclosure around a circular automatic buffer. This is being constructed of pre-fab slotted angle iron.

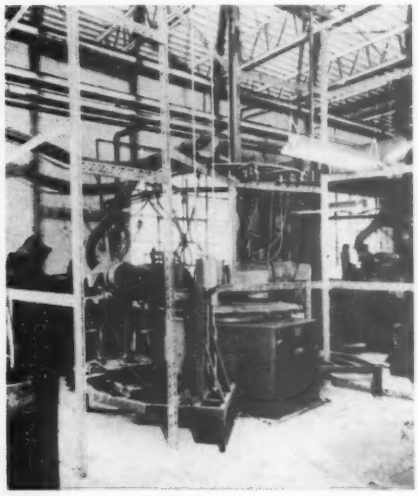


Fig. 4: Left, the construction of a pre-fab slotted angle iron enclosure around a circular automatic buffer.

Laboratory Ventilation

An area of great interest at the present time and one which holds a large potential for the future is the chemical laboratory. Research is constantly unfolding new materials and new techniques for the chemist, and the science of radiochemistry is just beginning to develop to the point where we will find radioactive materials in many laboratories, from the industrial plants to our schools.

At present time there is some controversy about the proper face velocity to use when exhausting a bench type of laboratory hood. On the one hand, the Committee on Industrial Ventilation recommends the minimum of 100 fpm and higher for radioactive materials; many manufacturers and some designers are recommending velocities of 50 fpm or lower.

The use of the lower velocity is not based on principles of good ventilation control but is more often caused by a desire for air conservation.

This is due to:

1. The difficulty of supplying large volumes of air to the laboratory.
2. The cost of conditioning this air.

At one of the large metal processing plants in Michigan the materials used in the laboratory include sulphuric, fuming nitric and hydrofluoric acids.

There was a great deal of concern about exposure of the chemists to fuming nitric and hydrofluoric acids because of generally inadequate ventilation. Tests indicated that hood face velocities averaged from 50–75 fpm, with wide fluctuation and considerable escape of material in some areas. This was due in part to the low exhaust volume and also in part to the methods by which air was supplied to the room. Air supply was by means of circular diffusers; because of space problems the diffusers were close to the hoods and at the low ceiling height and high volumes, drafts were bound to occur.

Recommendations included replacement of the fans which had become badly corroded, increase of exhaust volumes to a minimum of 100 fpm through the face openings and make-up air to be supplied through a perforated false ceiling below the original ceiling.

In the course of installation a new hood was added across the south side of the room (Fig. 5). This increased the number of hoods in the roof to five and increased the air volume considerably, since the open face of this hood is 20 ft. long. Follow up was done on this installation in February 1960, testing the exhaust ventilation and the make-up air volume. Hood face velocities were considerably over the minimum and the plant is aware that these volumes can be reduced.

There has been no attempt made to reduce the exhaust. No doubt, as fans are subjected to corrosive action there will be a natural reduction in exhaust.

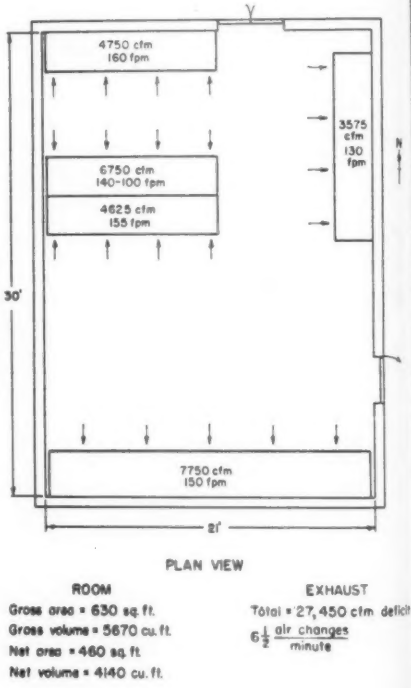


Fig. 5: Right, a plan view of the hoods above buffing machines, giving total area, exhaust, volume and changes per minute.

The total exhaust volume measured was 27,450 cfm. With allowance for the space occupied by the hoods, this amounts to *6½ air changes a minute!*

Obviously there would be a serious problem here if there were no make-up air and if the air was not distributed carefully. From this plan view you can see that there is not much net ceiling or floor area between the hoods and it would be most difficult to introduce this air by normal methods.

Fig. 6 illustrates the method used. The air supply unit was located away from the lab and the air was brought in through overhead ducts and distributed

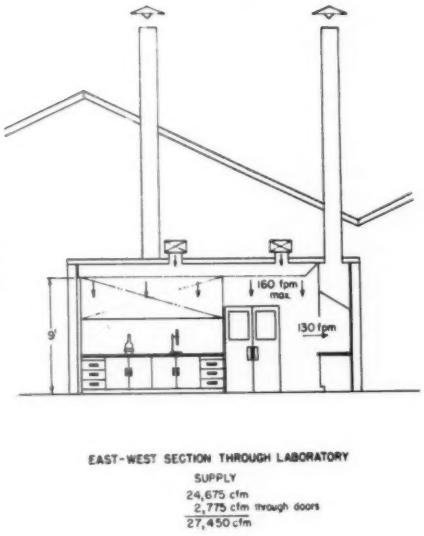


Fig. 6: Right, a section view of the make-up air method and volume of air supply.

into the space between the existing ceiling and the new false ceiling. The false ceiling is made up of 12 x 12 in. metal tile; each tile has approximately 1000 3/32 in. stamped holes. Air from the plenum passes through these holes and is distributed very uniformly. Air velocity measurements indicate that the velocity drops off to approximately 50 fpm within 3–4 in. of the panel face.

All of the air does not come through the holes because it is apparent that there is some leakage at the edges of each tile where they are fastened together with a patented arrangement. The net result of all of this is that the plant is able to supply approximately 24,675 cfm through this ceiling, the balance of the air required, (2,775 cfm) enters the laboratory through either of the two doors by leakage. This serves to keep the lab under negative pressure and prevent any spread of materials which might be spilled outside of the hood.

Good Air Distribution

There is no perceptible air movement in the laboratory to cause undesirable drafts or cold or warm areas. The air temperature is dependent almost entirely on the make-up air supply temperature which is regulated at the unit. It is difficult to evaluate a comparative cost of supplying air by this method as opposed to ductwork and conventional grills since conventional methods could not have been used in this application. It is apparent though that a great deal of ductwork would have been required to distribute the air between the hoods and this cost would offset a share of the cost of the metal ceiling, without having the clean, uncluttered appearance that is now available.

This is a solution to the problem of introducing large volumes of air at high change rates into a laboratory area, and this is done at reasonable cost for air distribution without sacrificing the ventilation control necessary at the hoods.

The problem of conditioning for comfort has yet to be solved in this lab. This is an interior room subject to heat load from the surrounding area and from the roof which is black asphalt. The plant hopes to complete a program of treating the roof with aluminized paint; further improvement can be obtained by ventilating the space between the roof and the laboratory ceiling.

Further comfort control can be obtained by doing a minimum amount of cooling of this air either with an evaporative cooler or with mechanical refrigeration. By reducing the outside heat load from the roof, and exhausting any hot processes in the hoods, we can think in terms of comfort ventilation with EFFECTIVE TEMPERATURE.

It is well known from the comfort ventilation research done by the ASHRAE that air temperature, velocity, and moisture can be equated to give satisfactory comfort; these comfort charts are reproduced in the Industrial Ventilation Manual.

In this direction, look for improvement in conditioning of our laboratories without incurring prohibitive air conditioning costs or reducing our ventilation below acceptable minimums.

Pneumatic Tool Dust Control

Several manufacturers are now offering dust control devices for use with pneumatic tools for drilling in coal mines, hard rock mines, quarries and many construction applications. These include drills which have built-in exhaust systems and in one case a separate auxiliary dust collection system which is stated as being applicable to any make of drill.

Westinghouse Air Brake Co., LHV45 sinker drill with the LX-1 dust collector, and the Thor No. 390-DL dustless push feed drill both provide a dustless atmosphere for rock drilling. These drills are similar in application and design although they will vary in detail. Basically, each uses a *special drill bit with a number of exhaust holes.* The usual *number is five.* A hollow drill steel connects the bit to the drilling machine.

The *hole diameter* will vary with different models but will be in the range of 3/8 to 7/16 in. diameter. In operation a compressed air ejector exhausts air through the holes in the drill bit and the hollow drill steel to a manifold inside the drill housing. The air is piped through a flexible hose to the dust collector which can be located at some distance from the drill. The air exhausted from the hole removes the dust before it becomes airborne; the dust is collected in the arresting unit which consists usually of a settling chamber and several filter bags. Depending upon models, the necessary vacuum to induce the air through the dust exhaust system can vary from 5–16 in. Hg. Compressed air consumption will be in the range of 18–100 cu. ft. at 80 lbs./sq. inch.

The U. S. Bureau of Mines, Dust Research Section, says in part, "The dust collecting systems of all these

(Please turn to page 45)

? ? ? ? ? ? ? Questions & ANSWERS ? ? ? ? ? ? ?

Effect of Microwaves On Human Body

Would like data on the injurious effect of microwaves on the human body.

N.D.R.
Chicago, Ill.

Answer:

Microwave Radiation: "Microwave radiation" is a term which generally refers to radio waves having frequencies from 1,000 to 30,000 megacycles, corresponding to wavelengths of 30 centimeters (cm.) to 1 cm. Radar utilizes microwaves having wavelengths from about 1 to 100 cm. (30,000 to 300 megacycles).

Three of the common operating wavelength bands are generally referred to as the "X", "C", and "S" bands and are in the regions of 3, 6 and 10 cm., respectively.

Heating Effects

The absorbed energy from microwave radiation results in heating of body tissue and temperature rises that may, at certain levels, produce biological damage.

If the normal body cooling functions, such as blood circulation and perspiration, cannot carry away this heat fast enough, the temperature in the tissue may become sufficiently high to cause permanent injury. The eyes and testes have been considered especially vulnerable to damage because of their relatively inefficient conduction of heat to surrounding tissues.

Also irradiation of the abdominal organs, which lack adequate blood supply for temperature regulation, may be particularly serious. Persons having metal implants should be aware that the heat in tissues adjacent to the implant may become excessive during exposure.

Injurious Wavelengths

Microwave radiation having wavelengths below 3 cm. has most of its energy dissipated in the skin and probably is not dangerous from the standpoint of biological heating effect. Three cm. ("X" band) radiation is absorbed in the skin, giving a sensation of heating which provides an adequate warning.

The absorption of heat from wavelengths between 3 and 10 cm. (including 6 cm. "C" band) may occur under certain conditions, depending on complex characteristics of the skin and fat layers. Studies indicate that few biological injuries have resulted from exposures to microwave energy having wavelengths less than 10 cm.

Ten cm. ("S" band) and longer wavelengths may be absorbed below the skin where, although there is little sensation, damage may occur because the circulation is inadequate to carry off the heat. As a result, serious damage may occur without warning being given. The eyes also seem to be very susceptible to 10 cm. radiation.

The range between 25 cm. and 200 cm., while currently not extensively used, is considered to be hazardous from the standpoint of whole body heating.

Effects on Eyes and Eye Protection

The crystalline lens of the eye is considered to be the tissue most sensitive to microwave energy and exposure may cause opacities of the lens (cataracts). Eye cataracts have been reported that may have resulted from lengthy exposure to microwave radiation in the 9 to 18 cm. range with power densities of up to 0.12 watts/sq. cm. It has recently been reported however, that such opacities have not been observed from exposure to power levels below 0.12 watts/sq. cm. regardless of the duration of exposure

Athermal Biological Effects

Recent studies have also indicated that exposure to extremely high frequency radiation (probably beyond 20,000 megacycles) may produce an electrical effect on nerve impulse propagation. All evidence to date, however, indicates that the only detrimental biological effects of microwave energy are those caused by heating.

Use Of Ozone

We are puzzled by the continued heavy promotion on the part of major manufacturers of ozone air purifiers by various names, especially in view of the fact that a number of Government agencies use such words as "extremely harmful," "lethal" and so on in describing the effect of ozone.

It is our understanding that the concentration of ozone which does any good in connection with the purpose intended is definitely toxic and harmful to human beings, and that the only way this toxicity and harm can be avoided is to have the concentration of ozone so low that it no longer performs the functions for which it is intended.

If the Department of Health, Education, and Welfare, FDA and other Government departments are wrong about this, it would certainly seem that you have a real story. Would appreciate hearing from you.

O.C.M.
Glen Riddle, Pa.

Answer:

Ozone producing equipment should be used with caution. In certain conditions concentrations in excess of maximum allowable concentration from the standpoint of safe health exposures can be produced. So called "Ozone Air Purifiers" are not effective in nullifying carbon monoxide and exhaust gas exposures and should not be used in these exposures in lieu of adequate exhaust ventilation.

The maximum allowable concentration of ozone, as given in the threshold limit values of American Conference of Governmental Industrial Hygienists is 0.1 parts per a million parts of air for a continuous 8 hour exposure. This value is generally accepted by most governmental agencies. Some of the effects of Ozone at various concentrations are given as follows:

Observed Effect	Concentration P.P.M.
In atmosphere after electrical storms	0.01—.05
Threshold of odor	0.01—.015
Maximum allowable concentration	0.1
Disorders of breathing, reduced Oxygen consumption and shortens lives of guinea pigs	0.5 —1.0
Headache, respiratory irritation	
Possible coma	1.0 —10.0

(Please turn to page 52)

Economic$ of Factory Air Conditioning

(Continued from page 25)

NEW INDUSTRIAL BUILDINGS

Typical Owning and Operating Costs per sq. ft. per year.

$$\frac{\$\ .46}{\$36.10} = 1.3\%$$

1.3% increased working efficiency is required to pay for complete year-round air conditioning.

cents per sq. ft. per year or 1 percent of the total cost.

This means that if the efficiency of the workers in the industrial building is increased *only 1.3 percent, the system will pay for itself.*

If a less than complete air conditioning system is installed at a first cost saving of 20 percent, the cost to own and operate the system will be 40 cents or .9 percent of the total cost. In other words, a complete system only increases the total owning and operating costs by .1 percent.

Existing Industrial Buildings

In a typical existing industrial building, the cost of owning and operating the building has dropped from $1.92 to $1.33 because it is assumed to have been built 20 years ago and its construction cost was about one half of today's building.

The cost of owning and operating air conditioning has risen from 46 cents to 55 cents because it costs more initially to install air conditioning in an existing structure. The initial cost is up from $3.13 to $4.00 per square foot. But even here, the investment is a sound one because efficiency increase needed *is only 1.5 percent.*

If a less than complete system is installed at a first cost saving of 20 percent, the owning and operating cost per sq. ft. will be 47 cents, which is 1 percent of the total cost. Here again, an increase of only

(Please turn to following page)

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Los Angeles 23, California

Economic$ of Factory Air Conditioning

(Continued from preceding page)

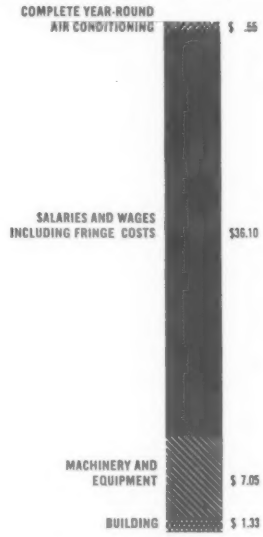
.2 percent in the total cost would provide for a complete and flexible system.

The owner of an industrial building may want to start his air conditioning investment in those departments where the least return is required to pay for the system.

Note the illustration showing typical costs of factory production operations in various departments in a typical plant. In the punch press department, for example, the efficiency increase required is 2 percent, while in the die repair department it is only .6 of 1 percent. ▲▲

EXISTING INDUSTRIAL BUILDING

Typical Owning and Operating Costs per sq. ft. per year.



$\frac{\$ .55}{\$36.10} = 1.5\%$

1.5% increased working efficiency is required to pay for complete year-round air conditioning.

CREDITS

Material for this article on the economics of factory air conditioning was based on data supplied by the following persons and firms:

- *J. E. Haines,* vice president, commercial division, Minneapolis-Honeywell Regulator Co.
- Carrier Air Conditioning Co., Div. of Carrier Corporation.
- *Ralph A. Gonzales,* chief application engineer, Airtemp Div., Chrysler Corp.
- *C. W. Millsom,* v. p., Perfection Division, Hupp Corp.

New Ideas In Ventilation

(Continued from page 41)

drills fall into the low volume, high velocity exhaust system category. The flow through the dust collecting system to the various drills, range from 6–20 cfm and air velocities in various parts of the system range from 2,000–14,000 fpm. The resistance to air flow is as high as 16 in. Hg in some of the systems."

Many of these dustless drills bear the approval of the U. S. Bureau of Mines under schedule 25-A, Part 33, "Dust Collectors for Use in Connection with Rock Drilling in Coal Mines."

This schedule stipulates conditions of test for these dust collecting devices. Under test conditions breathing zone dust samples are taken with the standard midget impinger method during the drilling of a series of 10 consecutive holes, ranging from vertically upward to various angles through the horizontal to the downward direction.

Testing Standards

The test is conducted in a suitable heading of the Bureau's test coal mine; the heading is not ventilated except as provided by the tool itself, and the test area has a volume of approximately 2,000 cu. ft. equivalent to an area 20 ft. x 10 ft. with a 10 ft. ceiling. A control count is obtained before the sequence of testing begins.

To pass the test the dust collection equipment must permit not more than 10 million particles per cu. ft. of dust in the operator's breathing zone; calculations of the average concentration of dust determined by the test samples are based on at least 80 percent of the samples collected during the test period.

Naturally, there are other requirements this equipment must meet, but the dust count information is of the greatest interest.

The other type of equipment mentioned is the dust collecting device which can be applied to any drill or pavement breaker. This piece of equipment is manufactured by LeRoi Division of Westinghouse Air Brake Company. It would appear to be highly effective for this application, although it is not indicated how it can be applied to holes which are drilled horizontally or at angles upward.

We bring this equipment to your attention because of its obvious applications to many of our problems. It should be mentioned however that it cannot be applied indiscriminately; this is emphasized by the Bureau of Mines.

The Bureau of Mines tests are conducted in an experimental coal mine maintained by the Bureau and care is taken to select rock strata which are typical of the coal mining industry. Differences in strata can produce different amounts of respirable dust and it may be that some applications will be beyond the limits of this equipment. ▲▲

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New Literature

"Formula For Dust Control"

● Bulletin on engineered fabrics and custom dust bags. Includes table of comparative fabric properties, consideration of special problems: fire due to inflammable dust or gases, mildew attacking the dust bag, abrasion of the dust bag "boots" before the rest, and how to get lower pressure drops with a greater degree of particle retentivity.

Also included in the bulletin are product advantages and sources.

Source: *The National Filter Media Corp., Dept. AE-2, 1717 Dixwell Ave., New Haven 14, Conn., Bulletin AE-14.*

New Turbo Blower Bulletin

● Describes Turbo Blowers for use in areas of combustion, atomizing, agitating, blowing, cooling, drying, conveying and exhausting.

Models outlined are available in direct, V-belt, or coupled drives with a pressure range of 4 to 44 psi and rated volume of 60 to 14,300 cfm.

Source: *North American Mfg. Co., Dept. AE-2, 4455 East 71st St., Cleveland, Ohio, Bulletin 300.*

Processing Equipment Bulletin

● New 16-page bulletin illustrates and describes dryers, calciners, kilns, coolers, coaters, spheroidizers, flash drying equipment, refractory-less furnaces, combustion equipment, air handling systems, air pollution control systems, cookers, digesters, granulators, mixers, pug mills, presses, extractors, counter-current washers, pilot plant units, reactors, roasters, distillation towers, and other specialized machinery.

Included are more than 75 photographs, as well as numerous drawings and diagrams.

Source: *Edward Renneburg & Sons, Co., Dept. AE-2, 2639 Boston St., Baltimore 24, Md., Bulletin G560.*

High Velocity Air Valve

● Outlines the operation of the Pneumavalve, high velocity air valve, using no air motors or mechanical linkages. Also gives dimensions and ratings for single and dual type ducts. Said to give instant response in infinite increments with pneumatic control system.

Source: *Connor Engineering Corp., Dept. AE-2, Danbury, Conn., Bulletin K-46.*

Assembling Complete Clean Rooms

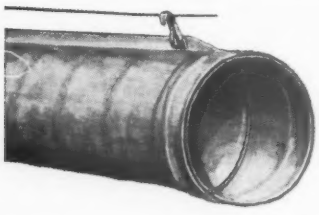
● Outlines the advantages of purchasing complete clean rooms, to include design, pre-engineering, installation and personnel training.

Also illustrates a clean room and factors it should include for efficient operations.

Source: *Controlled Environment, Inc., Dept. AE-2, 52 Pickering St., Needham 92, Mass., Bulletin 15M1060.*

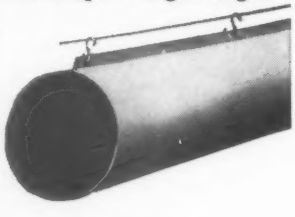
NEW!

ABC WIRE REINFORCED



Flexible Ventilation Tubing

For safe, economical removal by suction of fumes, fouled air, dust from bilges, manholes, tanks, furnaces, mines, or for blowing in fresh air. Neoprene coating is airtight, resists friction, oil, moisture. Withstands flexing. Reinforcing wire completely covered. Easy to hang and couple. Lightweight—only 1/3 of metal duct. Flame resistant. Retractable for carrying or storage. Also plain tubing for blowers.



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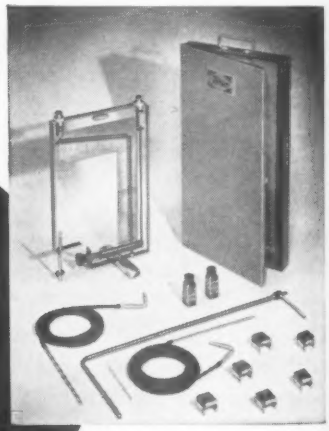
340 King's Hwy., Warsaw, Indiana

Dwyer CONTROLS GAGES

AIR VELOCITY METER No. 400

One Instrument Tells Both Air Velocity and Static Pressure!



- Reads directly in feet per minute and inches of water.
- Check *all* velocities from 400 to 10,000 F.P.M.
- All static pressures from 0 to 10" of water.

Tests fan and blower discharge and inlet pressures, pressure drop across filters, balances air conditioning systems, etc. Complete kit includes dual purpose manometer, 18" stainless steel pitot tube, Magneclips and all necessary fittings, tubings, instructions and accessories.

Write today for literature and prices.

F. W. DWYER MFG. CO.

P.O. BOX 373-A MICHIGAN CITY, INDIANA

Integrated Building Design With Mechanical System Layout

(Continued from page 33)

hausting relief air through the the perimeter zone heat pump air condensers permits a reasonable high coefficient of performance, in spite of low outside air temperatures. Package heat pumps are available in a wide range of sizes, and were matched and arranged to provide partial load control from 100 percent to 25 percent. Winter power demand is effectively stabilized by balancing day lighting with a comparable demand for night compression heating. This type of integrated heat pump system can maintain uniform temperature control, and follow a reversal of thermal load resulting from variable outdoor conditions.

Separate heating and cooling systems are subject to some serious limitations when simultaneous heating and cooling demands exist within the building, namely: (1) Excessive heating and cooling equipment capacity must be provided; (2) System response to rapid variation in internal or external load usually involves some degree of overheating, overcooling and lag; (3) System control is poor on light partial load.

From the standpoint of air conditioning during summer seasonal cycle alone, there are several advantages worthy of note. For example, this system permits heat absorption from lights directly in ceiling plenum with high temperature return air. Not only is heat removed from lights before it becomes a factor in space comfort, but is achieved with air otherwise unavailable to do further cooling. This, in effect, reduces the amount of total air circulated for any given cooling load. Furthermore, since a portion of the return air becomes exhaust, some of the building sensible load is continuously "dumped overboard," reducing the required installed refrigeration tonnage for any given design loads.

Benefits resulting from the design of this integrated mechanical-electrical-structural system are given below:

- System utilizes internal lighting heat gains as a source for building heat losses.
- Each zone system instantly changes from cooling to heating as the building thermal load reverses.
- Package heat pumps arranged to control from 100 percent to 25 percent partial load.
- Systems arranged so use of atmospheric cooling for interior zone permits obtaining high C. O. P. on perimeter heat pump units.
- System design provides stabilization of power demand.
- Reduced installed equipment.
- Elimination of separate heating system.

System designs as illustrated in the previous examples are significant in that they illustrate the principle of integration of building systems. Both these systems, however, do not use dual purpose components (i.e.) prefabricated components designed to be common to two or more building systems. To realize the full potential and to achieve total environment, prefabricated products i.e., lamps, ballast, wiring, ductwork, air handling equipment, and structural members must be designed as components of two or more integrated building systems.

Dynamic integration shall be discussed in a subsequent article which will illustrate how the design of dual purpose products can significantly improve the efficiencies of two or more building systems, with a reduction in total energy required, resulting in the creation of total environment.▲▲

Navy Investigates "Happy Ions"

The U. S. Navy has found negative ions to be a new tranquilizer which keep morale high aboard submarines. Negatively charged ions in heavy concentrations provide an increased sense of well being. They can be as effective as tranquilizers in providing "that happy feeling."

Studies on the physical effects of ions in the atmosphere are under way at the Navy's Medical Research Laboratory submarine base in New London, Conn. Studies also are being made in Washington at the Naval research Laboratory.

AIR ENGINEERING will run an article on negative ions soon.

AS EXHIBITED AT THE STATE OF MAINE EXPOSITION

FOR DUST-FREE LOCATIONS

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GUARANTEED EFFICIENCY

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Nappi #6 No Charge

LIBERTY MACHINE CO.
P.O. Box 172
598 Deming Road
Berlin, Connecticut

Product of the Month . . .

For White Rooms

NAPPI DUST CONTROL Equipment dealing only with the removal of dust, dirt and bacteria from shoes in "super-clean" areas is the February *New Product of the Month.* Unit combines. . . .

● Six rotating brushes held under tension to enable them to fit the contour of any shoe and poke into the many and varied folds and seams and joints of shoes regardless of style or size. Depending upon the specific use to which the Nappi Equipment will be used, the brushes installed can be of six different types of materials. White nylon, because of its softer texture, is used in applications normally requiring the cleaning of white shoes. The combination of black nylon and stainless steel is usually used for units which will be installed in areas requiring a stiffer bottom brush, for example: the cleaning of carbon-soled shoes worn by hospital operating-room staffs. This combination brush, because of its abrasive qualities, also provides protection by preparing

the soles of shoes for positive ground against static electricity. Other brush types used in Nappi Equipment include: black nylon, mixed tampico, horsehair, and goat hair. Each has its specific advantage depending upon end-use.

● Provision for available or attached vacuum devices. And for installations where the control of bacteria is paramount, an optional accessory for spraying a germicide on shoes while the shoes are being cleaned is also available.

● Rugged outer case to fully enclose and trap every bit of removed dust and dirt.

All power from the motor to the brushes is transferred through a series of timing belts and gears sealed in a dustproof grease box. The toothed timing belts are stretch and slip-proof and provide positive drive. Each Nappi shoe-cleaning unit is a piece of engineered apparatus designed and buillt to be rugged, durable, and extremely effective and efficient.

There is now available for use in "white rooms," and precise assembly rooms, and quality control centers and laboratories, and hospitals, a specific model of this equipment.

Demonstrations can be arranged on request. For further information contact: *Nappi Equipment, AE-2, 598 Deming Rd., Berlin, Connecticut.*

LOCK OUT "WHITE ROOM" CONTAMINATION

For "white room" security: Complete line of electric interlocks, electric indicating units and electro-mechanical locks. Send us your requirements. Our experienced staff of engineers will return design recommendations and quotation promptly. Remember the name — ADAM — first in "white room" control.

FOLGER ADAM COMPANY

Security Equipment
●
Institutional Hardware

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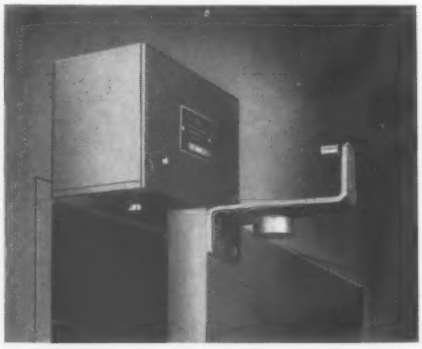

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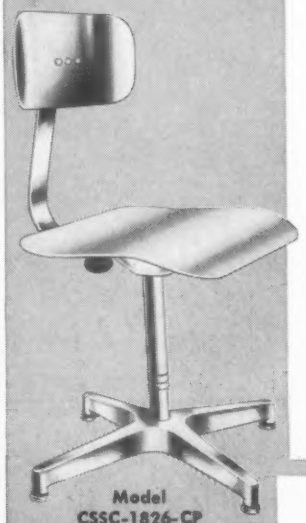
SPECIAL CHAIRS FOR WHITE ROOMS AND DUST FREE AREAS



Model CSSC-1826-CP

- All Enclosed Mechanism
- No Oil or Grease
- All Chrome Plate Finish
- Easily Cleaned
- 12 Ga. All-Steel Seat; 14" x 15⅝"— Waterfall Form. Sand Blast Surface. Adjusts 18" to 26".
- 12 Ga. Steel Backrest; 6" x 13¾"—with tempered steel backrest support. 6 inch horizontal adjustment. Backrest folds down to make easy cleaning.
- Cast Iron Base; 20-inch spread. 1⅛" steel glides.

Other White Room chairs with lacquered plywood seat and backrest.

FREE TRIAL Use an AJUSTRITE chair for 30 days without obligation. Prove to yourself the many advantages AJUSTRITE offers in comfort, utility and economy. Write today—we'll do the rest.

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32 Models for Factories • Schools • Laboratories • Hospitals • Offices

AJUSTRITE CHAIRS AND STOOLS

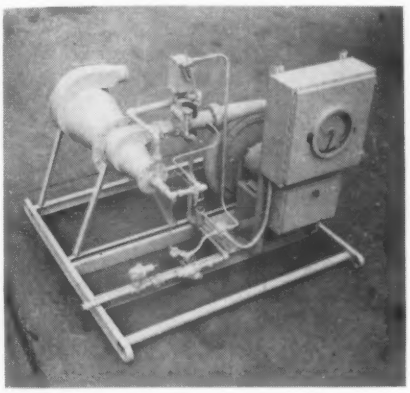
AJUSTO EQUIPMENT CO.
Bowling Green, Ohio

New PRODUCTS

Direct Fired Air Heater

Purpose: Heating process air for spray or fluidized bed dryers, direct heating of furnaces, etc., and multi-heater temperature zone control on continuous dryers or kilns.

Features: High combustion efficiency and absence of impurities plus a wide range of air-to-fuel ratios—from 50 percent stoichmetric to 100 time theoretical air requirements without loss of flame.



The reactor flame rates up to 10,000,000 Btu/hr per cu. ft. of combustion volume, immediate response up to 3,000°F. to changing temperature requirements is possible and the "Q-PAK" is available in sizes from 100,000 Btu/hr. to 10,000,000 Btu/hr./heat release.

Source: Black, Sivalls & Bryson, Inc., Dept. AE-2, 7500 E. 12th St., Kansas City 25, Mo.

Incinerator Selector Rule

Purpose: To simplify the selection of correct incinerators for various types of installations. Issued by Morse Boulger.

Features: Determines not only type but incinerator size as well. Operates similar to a sliderule. To use the selector, a slide is moved to the type of installation and appropriate "factor." In the case of apartment houses the variable factor is the number of persons; with restaurants, the number of meals, and in hospitals the number of beds, etc.

The recommended incinerator appears in a window opening, directly opposite the number of operation hours. Selector takes into account variable factors, including type of waste. Size 4¼ in. x 11¼ in. charge. ▲▲

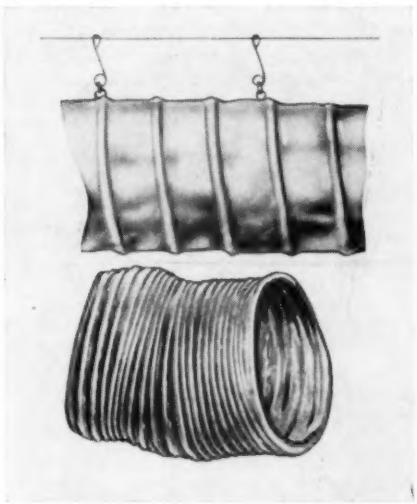
Source: Morse Boulger, Inc., 80 Fifth Ave., New York 11. No

Ventilation Tubing

Purpose: Provides economical, flexible ventilation tubing for temporary heating and for exhausting smoke or fumes from welding operations, etc.

Features: A lightweight tubing made of spirally wrapped heavy cotton fabric, coated throughout with Neoprene, is air-tight, wear resistant, mildewproof, flame resistant, and can be installed by one man.

Available in convenient lengths in diameters from 8″ to 36″ and can be used in temperatures from -40°F. to -250°F.



Source: American Brattice Cloth Corp., Dept. AE-2, King's Highway, Warsaw, Ind.

Airborne-Particle Size Analyzer

Purpose: A self-contained instrument equally useful for research as for monitoring the presence and distribution of particulate matter in the atmospheres of such areas as clean rooms for precision manufacture and assembly.

Features: The new model PC200A is built in standard 19-in. modular panels integrated into a

31-in. high cabinet. The PC200A can be programmed automatically and presents immediate displays of the numbers of particles present in 15 sub-ranges of sizes. Counts appear visually on decade counters, but can be recorded on digital tape or a strip-chart recorder, or both.

Source: Royco Instruments Inc., Dept. AE-2, 440 Olive St., Palo Alto, Calif.

Roof Ventilator

Purpose: Designed to supply filtered air in sufficient quantity for most industrial applications.

Features: Unit utilizes permanent air filters; delivers approximately 6000 cfm at "0" sp at only 860 rpm, with standard ¾ hp motor. Filter velocity is 300 fpm and filtration efficiency is said to approach 100 percent on all particles in the 10-20 micron range. The assembly is of low silhouette for neat roof appearance.

Source: Western Engineering & Mfg. Co., Dept. AE-1, P.O. Box 66455, Los Angeles 66, Calif.

(Please turn to page 50)

New PRODUCTS

Potentiometer Smoke Recorder

Purpose: To record broad smoke spectrum.

Features: Sensitivity may be adjusted to cover a desired range of smoke spectrum as wide as from 0-100. Charts graduated from 0-100 with Ringelmann numbers are available. Optimum haze may be set at "50" if accuracy of good combustion hazes needed.

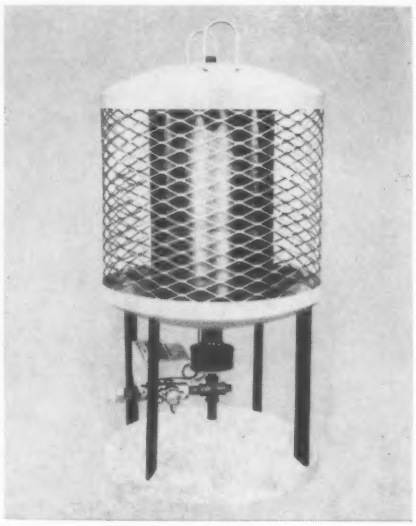
Recorders may be installed on both old and new boilers and are necessary for enforcing "smoke abatement" programs.

Source: Photomation, Inc., Dept. AE-2, 96 S. Washington Ave., Bergenfield, N. J.

Portable Radiant Gas Heater

Purpose: To produce radiant heat for unheated indoor work areas or as supplemental heat for "hard to heat" areas in large buildings.

Features: The intensely hot



products of combustion are forced out of tiny holes in the stainless steel heat exchanger thus causing the entire surface to glow red hot. The cylindrical heat exchanger beams radiant energy off this red hot surface outwardly until it strikes a solid object. According to the manufacturer this enables Space-Ray to produce twice as usable radiant heat, and beam it out over a larger area, than old style heaters.

Source: Space-Ray Corp., Dept. AE-2, P. O. Box 3485, Charlotte, N. C.

Radiation Slide Rule

Purpose: Reduce time required to obtain information relating to radiation from a black body.

Features: Direct readings of values in both watts and photons per sq cent. are possible; twin temperature scales provide readings in centigrade or absolute from -180°C. to 10,000°C. Quantities such as radiant flux density can be obtained for a black body between $\lambda=2X10^2$ and λ $T=4X10^6$ micron degrees with accuracy to 1 percent.

Radiation slide rule F5100 has 7 scales on the stock and 6 scales on each face; the large slide measures 19¼" X 3¾" and costs $41.00.

something NEW you should know about "CLEAN" ROOMS

This four-page bulletin

describes a new service which provides complete, pre-engineered "clean" or "white" rooms in one package at one price — including installation and employee training. 31 construction and operational details of a typical dust-controlled clean room are illustrated.

Write for your free copy

Controlled Environment, Inc.
52 Pickering Street ◆ Needham 92 ◆ Massachusetts

Don't be disappointed next month - - -

Send in your subscription NOW for

AIR ENGINEERING

Write on your letterhead or use the handy order card in this issue. Be sure and state your company affiliations and job title.

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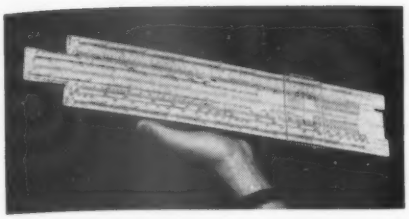
1 year, $3.00 — 2 years, $4.50 — 3 years, $6.00



Source: Walsh Engineering Sales Co., Dept. RS-1160, AE-2, Inglewood, Calif.

Dustkop Shaker

Purpose: For removal of fine dust that formerly accumulated to plug secondary bag-type filters.

Features: New design is a lever-type shaker, said to reduce manual effort and increase shaking efficiency. Because of a new shaking action, plus the design feature of positioning the bag above rather than at the side of the primary cyclone separator, it is claimed no longer necessary to remove the bag to maintain peak dust collection and filtering performance.

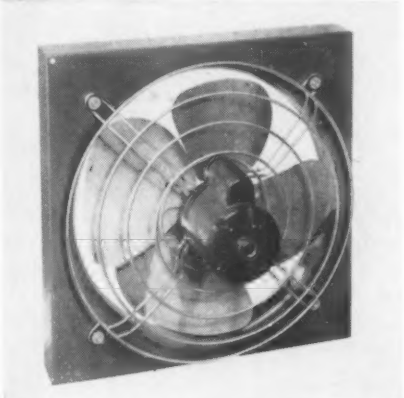
Source: Aget Mfg. Co., Dept. AE-1, Adrian, Mich.

Packaged Ventilating Fan

Purpose: Designed for commercial, industrial, and institutional buildings to reduce installation, maintenance, and operating costs.

Features: The fan and housing may be placed in a wall opening and connected to an electrical line. The fan guard serves as the mounting for a resilient motor and the fan itself. Complete with weather-sealed wall shutters. Fans are direct drive and come in seven sizes ranging from 12 to 31 sq. in.

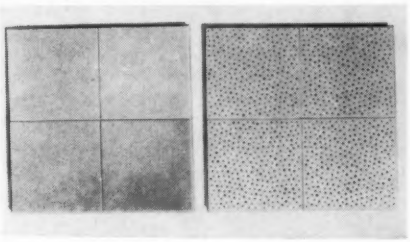
The fans, made of lightweight aluminum, are pitched and balanced to move air evenly. A wide variety of 60 cycle motors suited to every ventilating need are available.



Source: Modine Manufacturing Co., Dept. AE-2, 1500 DeKoven Ave., Racine, Wis.

Fire Protective Acoustical Ceiling Tile

Purpose: To provide a rated fire protection and eliminate dangerous heat transmission.



Features: Made of felted mineral fibers with special binders utilizing a formula and method of production which results in a time-rated fire protection eliminating other conventional methods of fireproofing.

Source: Elof Hansson, Inc., Dept. AE-2, Acoustical Division, 711 Third Ave., New York 17, N. Y.

Lead Peroxide Candle For SO_2 Sampling

Purpose: A basis for empirical comparison of sulphur dioxide concentration in the air.

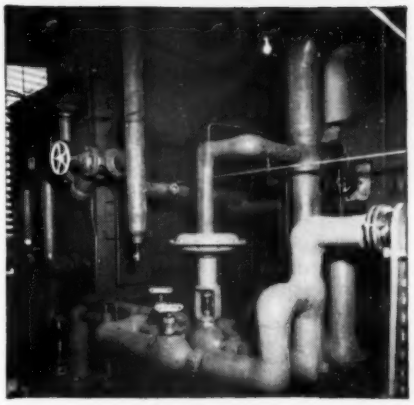
Features: The absorption of sulphur dioxide by the lead peroxide candle to form lead sulphate provides a simple, inexpensive method for comparing the concentrations of sulphur dioxide in the air at different places and at different times.

Source: Research Appliance Co., Dept. AE-2, P. O. Box 307, Allison Park, Pa.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material.

To contact manufacturers directly, street addresses are given. But please mention you saw it in AIR ENGINEERING.

DRY AIR...
PRECISELY AS YOU NEED IT



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

removes atmospheric moisture by direct contact with an absorbent liquid in a compact spray chamber. The spray contact temperature and the concentration of the absorbent liquid, two factors that are easily controlled, determine precisely how much moisture remains in the air leaving the unit.

This Niagara Controlled Humidity method, using Niagara Hygrol Absorbent Liquid is....

The only really precise method of air conditioning because it removes moisture as a separate function from heating or cooling to give you assurance of accuracy of air moisture control.

It is the most reliable because the absorbent is continuously and automatically kept at the proper concentration. No moisture-sensitive instruments are required to control your conditions.

It is the most flexible because with it you can either hold the precise condition you need as long as you wish or vary it with accuracy.

It is easiest to operate and maintain because the equipment and controls are simple and trustworthy.

This method is successfully used in the storage, testing and production of hygroscopic materials, in process control and as a pre-dehumidifier in comfort air conditioning.

Write for Bulletins Nos. 122 and 140.

Address Dept. AIR-2

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

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L. B. Hitchcock.....Edwin Cox
John H. Schaefer, Technical Advisor
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IS EUROPE ON YOUR MIND? Are you getting your share of the fastest growing market? Do you know that the terrific expansion of European heating, ventilating and air conditioning industries in the past 15 years is your opportunity to get into the world's second largest market now? European manufacturers of air handling equipment are groping with problems which your manufacturing and selling know-how can solve. Since 1954 I have successfully made profits in Europe for a small group of top concerns in the industry, managing their licensed manufacturing in Europe as combination Factory Representative and District Manager. Can take on one good additional account. Write without obligation and see me in Chicago during February ASHRAE Show. J. J. LA RUS, European Sales & Licensee Supervisor, 2, avenue Le Notre, Marly-le-Roi (S & O) France. New York Office: 450 12th Avenue, New York 18, N. Y., Telephone LO. 3-1380.

Q & A, Ozone Use

(Continued from page 42)

Lethal in few minutes	Greater than 1700
Germicidal for airborne organisms	6500

Ozone does combat odors and has been successfully used in odor control. Concentration of .015 to .05 P.P.M. are effective. Claims that ozone will detoxify carbon monoxide and exhaust gases freshen or purify the air, kill bacteria in the atmosphere of habitable spaces and other equally fantastic claims have not been substantiated.

Concentrations of ozone from the discharge of commercial ozonators can greatly exceed the maximum allowable concentration of 0.1 P.P.M. These ozonators should not be used in small confined spaces where excessive concentrations may result.

If air determinations of ozone are made for control purposes, ozone can be used for odor control in concentrations below the MAC without endangering the health of personnel.

'House Beautiful' Prints Article On Negative Ions

House Beautiful's Climate Control Project for February is an article by AIR ENGINEERING editor, Eugene A. Sloane.

The article, "Can Negative Ions Added To The Air You Breathe Improve Your Well-Being?" is written for the layman to interpret the research already completed, what to expect in the future and how to link this to their individual well-being.

For further information on the fast growing field of knowledge about the industrial and commercial benefits of negative ions, watch coming issues of AIR ENGINEERING.